EXPERIMENTAL STUDY OF AIR-WATER FLOW PROPERTIES ON LOW-GRADIENT STEPPED CASCADES

APPENDICES

Luke Toombes, B.E Civil (Hons.1), University of Queensland

Department of Civil Engineering,

Faculty of Engineering, Physical Sciences and Architecture

THE UNIVERSITY OF QUEENSLAND

Brisbane, Australia

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LIST OF SYMBOLS

a	Specific interface area, defined as the air-water surface area per unit volume [m^{-1}]
a_{max}	Maximum specific interface area at a section
a_{mean}	Depth-average specific interface area; $a_{mean} = \frac{1}{z_{90}} \int_0^{z_{90}} \frac{4 F_a}{V} dz$
$\overline{a}$	Cross-sectional average specific interface area
b	Width of the mixing layer
C	Air concentration, or void fraction, defined as the volume of undissolved air per unit volume of air and water
C_c	Contraction coefficient
C_d	Drag coefficient
C_e	Equilibrium depth-average air concentration for uniform flow
C_{gas}	Dissolved gas concentration defined as the absolute quantity of dissolved gas (e.g. oxygen) present per unit mass of the liquid, measured in parts per million [ppm], or milligrams per litre [mg/L]. Sometimes given as a percentage of the saturation concentration [$\%_{sat}$]
C_{mean}	Depth-average air concentration defined in terms of z_{90}; $C_{mean} = 1 - \frac{d}{z_{90}}$
C_{SAT}	(Saturation) concentration of dissolved gas in a liquid at equilibrium
ch_a	Air-bubble chord-length (i.e. distance between a water-air interface and the subsequent air-water interface measured along a streamline)
$(ch_a)_{mean}$	Time-average air-bubble chord-length; $(ch_a)_{mean} = \frac{V\,C}{F_a}$
ch_w	Water-droplet chord-length (i.e. distance between an air-water interface and the subsequent water-air interface measured along a streamline)
$(ch_w)_{mean}$	Time-average water-droplet chord-length; $(ch_w)_{mean} = \frac{V\,(1-C)}{F_a}$
D	Height of the gate opening
D_{gas}	Molecular diffusivity of gas in water [m^2/s]

D_H	Hydraulic diameter; D_H = 4×Area/Wetted Perimeter
D_T	Turbulent diffusivity [m²/s]
d	1: Flow depth measured perpendicular to channel floor
	2: Clearwater flow depth defined in terms of z_{90}; $d = \int_0^{z_{90}} (1-C)\,dz$
d_b	Depth at the drop brink
d_c	Critical flow depth; $d_c = \sqrt[3]{\frac{q^2}{g}}$
d_I	Flow depth at the inception point of air entrainment
d_M	Maximum vertical height of the sidewall standing-wave
d_t	Tailwater depth downstream of a dam or weir
d_p	Depth of the pool of water beneath the free-falling jet
d_0	Clearwater flow depth upstream of the drop
d_1	Flow depth downstream of nappe impact and/or upstream of a hydraulic jump
d_2	Flow depth downstream of a hydraulic jump
E	1. Specific energy; $E = d + \frac{V^2}{2g} = d + \frac{q^2}{2gd^2}$ (assuming uniform velocity, non-aerated flow, hydrostatic pressure distribution and horizontal channel bed)
	2. Aeration efficiency; $E = (C_{DS} - C_{US})/(C_{SAT} - C_{US}) = 1 - 1/r$
F_a	Bubble frequency, or number of bubbles or droplets per second [Hz]
F_{max}	Maximum bubble frequency in a section [Hz]
f	1: Darcy friction factor for non-aerated flow (smooth chute); $f = \frac{\tau}{\rho V_w^2}$
	2: Modified friction factor; $f = \frac{8}{Fr^2} S_f$
f_e	Darcy friction factor for aerated flow
f_{eq}	Modified friction factor for quasi-equilibrium flow; $f_{eq} = \frac{8}{Fr^2} S_0$
Fr	Froude number; $Fr = \frac{q_w}{\sqrt{gd^3}}$

Fr_0	Froude number upstream of the step brink
Fr_*	Froude number defined in terms of the roughness height, k_s
g	Gravitational acceleration; $g = 9.80\text{m/s}^2$
H	Total hydraulic head; $H = E + z$ (for a single step configuration, H is measured relative to the lower step level)
h	Step height
J	Momentum flux; $J = \int V^2(1-C)\,dz$
K	Von Karman constant. A 'universal' constant of proportionality between the Prandtl mixing length and the distance from the boundary. Experimental results indicate that K = 0.4
K_L	Mass transfer or liquid film coefficient
k_s	1. Macro-roughness height measured perpendicular to the channel bed [m] 2. Step dimension measured normal to the flow direction [m]; $k_s = h\cos\alpha$
k'_s	Surface (skin) roughness height [m]. For smooth a invert channel, $k'_s = k_s$
L	Step length
L_D	Horizontal distance from the upstream overfall to the impact of the centre of the nappe on the step below
L_I	Distance from the start of growth of boundary layer to the inception point of air entrainment
L_M	Distance to the peak height of the standing-wave
$L_{SW\text{-}W}$	Horizontal distance to the (projected) shockwave origin on the sidewall
$L_{SW\text{-}INT}$	Horizontal distance to the shockwave intersection on the centreline
L_{VC}	Distance from the gate opening to the vena contracta
M	Mean of a probability distribution function.
P_{atm}	Atmospheric pressure
Q_w	Flowrate of water [m³/s]
q_w	Flowrate of water per unit width; $q_w = \int_0^{z_{90}} V(1-C)\,dz$ $= Q_w/W$ for uniform flow depth
r	Deficit ratio; $r = (C_s - C_{US})/(C_s - C_{DS})$

Re	Reynolds number; $Re = \frac{\rho V d}{\mu}$
s	Standard deviation of a probability distribution function
S_f	Friction slope (gradient of the total head line)
S_0	Channel slope; $S_0 = \sin\alpha$
t_M	Width of the sidewall standing-wave at the location of maximum height; L_M
V	Longitudinal component of velocity along a streamline
V_b	Mean bubble velocity (or velocity of the air-water interfaces). If no slip occurs (i.e. bubbles travel at the same speed as the surrounding water), $V_b = V_w$
V_c	Critical velocity; $V_c = \sqrt[3]{q_w g}$
V_{mean}	Depth-average velocity; $V_{mean} = q_w/d$
V_w	Water flow velocity [m/s]
V_0	Average centreline velocity at a distance upstream of the step edge; $V_0 = \frac{Q_w}{W_u d_0}$
$\overline{V}$	Cross-sectional average velocity
W	Channel width [m]
We	Weber number; $We = \frac{\rho V^2 l}{\sigma}$
We_c	Critical Weber number for bubble break-up in turbulent shear flow
X	Dimensionless longitudinal distance; $X = x/d_0$
x	Longitudinal distance measured from the upstream step edge
Y	Dimensionless transverse distance; $Y = 2y/W$
y	Transverse distance measured from the channel centreline
Z	Dimensionless altitude or bed elevation; $Z = z/d_0$
$Z_{\#\#}$, $z_{\#\#}$	Elevation perpendicular to the bed corresponding to an air concentration of ##%
Z'	Dimensionless altitude (free-falling nappe); $Z' = Z - (Z_{50\text{-UpperNappe}} + Z_{50\text{-LowerNappe}})/2$
Z''	Dimensionless altitude (air-water interface); $Z'' = (z - z_{50})/\lvert z_{90} - z_{10}\rvert$
z	Vertical altitude or bed elevation

ΔH	Head Loss
ΔP	Difference between atmospheric pressure and the air pressure beneath the nappe; $\Delta P = P_{\text{atm}} - P_{\text{nappe cavity}}$
α	Overall channel slope
α_s	Slope of the step
β	Angle of the nappe impact on the step
δ_a	Thickness of the air-concentration boundary layer
δ_{99}	Thickness of the turbulent boundary layer
ε_k	Kinetic energy correction factor (Coriolis coefficient)
ε_p	Piezometric head correction factor
ϕ_a	Air-bubble diameter [m]
ϕ_m	Maximum air-bubble diameter [m]
μ	Dynamic viscosity [Pa s] (typically of water if no subscript)
ν_t	Momentum exchange coefficient, also called the eddy viscosity or virtual kinematic viscosity
ν	Kinematic viscosity; $\nu = \mu/\rho$ [m²/s] (typically of water if no subscript)
θ	Angle of shockwave
ρ	Density [kg/m³] (typically of water if no subscript)
ρ_{xy}	Cross-correlation coefficient
σ	Surface tension [N/m] (typically of water-air if no subscript)
τ_l	Laminar shear stress
τ_t	Turbulent shear stress
τ_0	Bed shear stress; $\tau_0 = \frac{1}{8}\rho V_w^2 f$

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APPENDIX A – THE BASICS OF AIR-WATER FLOW ON SMOOTH CHUTES, AND AN INTRODUCTION TO AIR-WATER MASS TRANSFER

A.1 FLOW PROPERTIES

When water flows down a smooth chute, the turbulence level at the free surface is initially small and the water surface has a smooth, glassy appearance. A turbulent boundary layer starts at the upstream end of the chute and grows downstream (Figure A-1). Turbulent velocities acting normal to the air-water boundary initiate free-surface aeration once the boundary layer reaches the free surface. Consequently, the location where the boundary layer reaches the free surface is known as the *point of inception*. Downstream of the point of inception, air-bubbles are entrained across the free-surface and the water becomes white and frothy, an appearance which gives rise to the term *white-waters*.

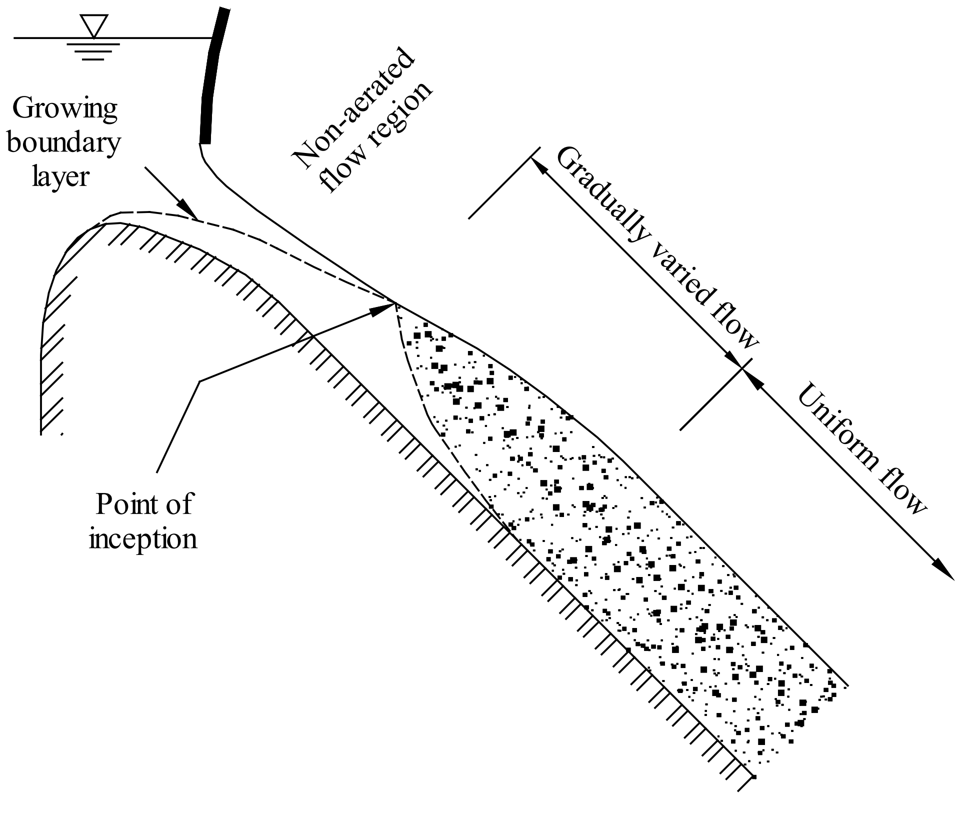


Figure A-1 Flow regions on a smooth chute

The location and depth of the point of inception, L_I and d_I respectively, are primarily a function of discharge and chute roughness. CAIN and WOOD (1981) derived an expression for L_I and d_I for smooth chutes from the boundary layer growth formula combined with the Bernoulli equation. Combination with parameters for smooth concrete spillways from WOOD et al. (1983) yields:

(A-1) $$\frac{L_I}{k'_s} = 13.6\left(\sin\alpha\right)^{0.0796} Fr_*^{0.713}$$

(A-2) $$\frac{d_I}{k'_s} = \frac{0.223}{\left(\sin\alpha\right)^{0.04}} Fr_*^{0.643}$$

where k'_s is the skin roughness height, α is the channel slope and Fr_* is a Froude number defined in terms of the roughness height as $Fr_* = q_w \Big/ \sqrt{g \sin\alpha \, k'^3_s}$.

The clearwater flow depth, d, and average velocity, V_w, for uniform equilibrium flow in a wide channel may be determined from the Momentum and Continuity equations as:

(A-3) $$\frac{V_w}{V_c} = \sqrt[3]{\frac{8\sin\alpha}{f_e}}$$

(A-4) $$\frac{d}{d_c} = \sqrt[3]{\frac{f_e}{8\sin\alpha}}$$

where f_e is the Darcy friction factor of the air-water flow, and d_c and V_c are the critical depth and velocity of the flow. The friction factor is a function of the surface (skin) roughness, k_s', channel slope, α, Reynolds number, and the quantity of air entrained.

JEVDJEVICH and LEVIN (1953), WOOD (1983) and CHANSON (1993a) showed that the shear stress is reduced by the presence of air within the turbulent boundary layer. Based on the reanalysis of numerous model and prototype data, CHANSON (1994) proposed an estimation for the drag reduction as:

(A-5) $$\frac{f_e}{f} = \frac{1}{2}\left[1 + \tanh\left(0.628 \frac{0.514 - C_e}{C_e\left(1 - C_e\right)}\right)\right]$$

where C_e is the equilibrium depth-average air concentration for uniform flow and f is the Darcy friction factor for non-aerated water. Drag reduction results in a higher velocity and reduced energy dissipation on the chute[a].

[a] Equation (A-5) was developed using smooth chute data. Current, unpublished data (CHANSON 2001a) indicates that the drag on stepped chutes with skimming flow also demonstrates some drag reduction caused by free-surface aeration, although the basic mechanism differs from smooth-invert flows.

A.2 AIR-CONCENTRATION DISTRIBUTION

Downstream of the inception point, air-bubbles are entrained at the free surface and the flow displays the 'white waters' characteristic of air-bubble entrainment. Analysis of free-surface aeration on smooth chutes by WOOD (1983) and CHANSON (1993a) showed that the average air concentration for uniform (equilibrium) flows, C_e, is a function of slope only, and is independent of upstream geometry and flow conditions. From the model data of STRAUB and ANDERSON (1958) and field data of AIVAZYAN (1986) it appears that the average air concentration for channels with a gradient of less than 50 degrees can be estimated as:

(A-6) $$C_e = 0.9\sin\alpha$$

The air-concentration distribution in self-aerated flows can be represented by a diffusion model for air-bubbles within the air-water mixture. Several such models are discussed below.

A.2.1 Model of WOOD (1984)

WOOD (1984) presented a conservation equation for the density of an air-water mixture in uniform flow (i.e. equilibrium flow, hence independent of longitudinal distance) as:

(A-7) $$-\varepsilon\frac{d}{dz}\left(\rho_w(1-C)\right) = \rho_w(1-C)w_f\cos\alpha$$

where ε is the diffusivity of the average density, α is the channel slope, z is the distance normal to the chute invert and w_f is associated with the fall velocity of water.

Reasonable assumptions about ε cannot be made without prior knowledge of the air-concentration distribution. Taking the simplest assumption that ε is constant (WOOD 1984), and assuming that $w_f = C\,z$ for $z < z_{90}$, integration of Equation (A-7) yields:

(A-8) $$C = \frac{B'}{B' + \exp\left(-G'\cos\alpha\left(\frac{z}{z_{90}}\right)^2\right)}$$

where z is the distance measured perpendicular to the invert, C is the time-average air concentration (volume of undissolved air per unit volume of air and water) at elevation z, and z_{90} is the depth where the air concentration is 90%. B' and G' are functions of the mean (depth-average) air concentration only, and α is the spillway slope.

The constants B' and $G'\cos\alpha$ are related by the condition that $C = 0.9$ at $z = z_{90}$, therefore:

(A-9) $$B' = 9\exp(-G'\cos\alpha)$$

Values for B' and $G'\cos\alpha$ are given in Table A-1.

Table A-1 Air-concentration distribution coefficients (after CHANSON 1992, 1993b)

C_{mean}	$G'\cos\alpha$ [a]	B' [a]	C_b [b]	$(V_{90}\,z_{90})/q_w$
0.0	$+\infty$	0	0	1.167
0.1608	7.999	0.003021	0.02	1.453
0.2411	5.744	0.028798	0.04	1.641
0.3100	4.834	0.07157	0.07	1.805
0.4104	3.825	0.19635	0.17	2.141
0.5693	2.675	0.62026	0.36	2.985
0.6222	2.401	0.8157	0.46	3.319
0.6799	1.8942	1.3539	0.55	4.151
0.7209	1.5744	1.8641	0.64	4.859

a from the data of STRAUB and ANDERSON (1958)
b computed using Equation (A-8): $C_b \approx B'/(B'+1)$ for $\delta_a << d_{90}$

The model of WOOD (1984) has been found to be consistent with experimental data for mean (depth-averaged) air concentrations between 10% and 75% in both the uniform and gradually varied flow regions on a chute. Unlike earlier models (e.g. STRAUB and ANDERSON 1958), WOOD's analysis considered the complete air-water flow as a homogeneous mixture, as opposed to separate regions for low and high air concentration. A shortcoming of WOOD's model is that the constants G' and B' have no physical meaning.

The air concentration near the channel invert deviates from Equation (A-8), tending to zero at the bottom. CHANSON (1992b) showed the presence of an air-concentration boundary layer for which the distribution is:

(A-10) $$\frac{C}{C_b} = \left(\frac{z}{\delta_a}\right)^{0.270}$$

where C_b is the air concentration at the outer edge of the air-concentration boundary layer and δ_a is the air-concentration boundary layer thickness. CHANSON (1992b) estimated δ_a as 15mm on smooth spillways, while C_b satisfies continuity between Equations (A-8) and (A-10). It is hypothesised that the bottom boundary layer may be due to the high shear stresses present close to the channel invert, resulting in bubble splitting (see Section A.3.1). Microscopic bubbles will be rapidly absorbed by the water, and will also be difficult to detect with conventional air-bubble measurement equipment.

A.2.2 Model of CHANSON (1995)

CHANSON (1995) developed an analytical solution for air-bubble diffusion based on the buoyancy of air-bubbles in water. In uniform equilibrium flow, the air-bubble diffusion due to turbulence normal to the surface is counterbalanced by the buoyancy effect. The continuity equation for a small control volume becomes:

(A-11) $$\frac{d}{dz}\left(D_{\mathrm{T}}\frac{dC}{dz}\right) - \cos\alpha\frac{d}{dz}\left(u_{\mathrm{r}}C\right) = 0$$

where D_T is the turbulent diffusivity (in the z direction), u_r is the bubble rise velocity and α is the channel slope. In a fluid of density $\rho_w(1 - C)$, u_r can be related to the rise velocity in a hydrostatic pressure gradient, $(u_r)_{Hyd}$ as:

(A-12) $$u_{\mathrm{r}}^2 = \left[(u_{\mathrm{r}})_{\mathrm{Hyd}}\right]^2(1-C)$$

Substituting into Equation (A-11) and integrating with respect to z yields:

(A-13) $$\frac{dC}{dZ} = \frac{C\sqrt{1-C}}{D'} + \text{constant}$$

where $Z = z/z_{90}$ and $D' = \dfrac{D_{\mathrm{T}}}{(u_{\mathrm{r}})_{\mathrm{Hyd}}\, z_{90}\cos\alpha}$ is a dimensionless turbulent diffusivity.

The solution of Equation (A-13) for a zero constant, assuming homogeneous turbulence (i.e. D' constant), is:

(A-14) $$C = 1 - \tanh^2\left(K' - \frac{1}{2D'}\frac{z}{z_{90}}\right)$$

where tanh is the hyperbolic tan function, K' is a dimensionless integration constant and D' is a function of the mean air concentration only.

The relationships between D', K' and C_{mean} are given by:

(A-15) $$C_{\mathrm{mean}} = 2D'\left(\tanh\left(\tanh^{-1}\left(\sqrt{0.1}\right) + \frac{1}{2D'}\right) - \sqrt{0.1}\right)$$

(A-16) $$K' = \tanh^{-1}\left(\sqrt{0.1}\right) + \frac{1}{2D'}$$

Typical values are listed in Table A-2.

Table A-2 Relationship between C_{mean}, D' and K' (after CHANSON 1995)

C_{mean}	D'	K'
0.01	0.007312	68.70445
0.05	0.036562	14.00290
0.10	0.073124	7.16516
0.15	0.109704	4.88517
0.20	0.146890	3.74068
0.30	0.223191	2.567688
0.40	0.311100	1.934650
0.50	0.423441	1.508251
0.60	0.587217	1.178924
0.70	0.878462	0.896627

A.2.3 Models of CHANSON and TOOMBES (2001)

CHANSON and TOOMBES (2001) proposed a number of advanced void fraction distribution models, developed assuming a non-constant diffusivity. Assuming that the dimensionless turbulent diffusivity varies inversely to the depth, i.e. $D' = \lambda z_{90}/z$ where λ is a constant, the analytical solution of Equation (A-11) yields:

(A-17) $$C = 1 - \tanh^2\left(K' - \frac{1}{4\lambda}\left(\frac{z}{z_{90}}\right)^2\right)$$

where K' and λ are constants related to C_{mean} as:

(A-18) $$C_{mean} = \frac{1.7637\times10^{-3} + 0.8643\,\lambda^{1.69}}{0.0947 + \lambda^{1.69}}$$

(A-19) $$K' = \tanh^{-1}\left(\sqrt{0.1}\right) + \frac{1}{4\lambda}$$

Equation (A-17) was found to match self-aerated flow data (CHANSON and TOOMBES 2001). A good representation of experimental data for skimming flow on stepped cascades was obtained by assuming that the turbulent diffusivity $D' = D_0\left(1 - 2\left(\frac{z}{z_{90}} - \frac{1}{3}\right)^2\right)^{-1}$, yielding:

(A-20) $$C = 1 - \tanh^2\left(K' - \frac{1}{2D_0}\frac{z}{z_{90}} + \frac{1}{3D_0}\left(\frac{z}{z_{90}} - \frac{1}{3}\right)^3\right)$$

where K' and D_0 are constant. The relationships between K', D_0 and C_{mean} are given as:

(A-21) $$C_{mean} = 0.7622\left(1.0434 - \exp(-3.614 D_0)\right)$$

(A-22) $$K' = \tanh^{-1}\left(\sqrt{0.1}\right) + \frac{1}{2D_0} - \frac{8}{81 D_0}$$

A.3 AIR-WATER MASS TRANSFER

A.3.1 Maximum Bubble Size

Maximum air-bubble size in turbulent shear flow is determined by the balance between the capillary force and the inertial force caused by velocity change over distances of the order of the bubble diameter. HINZE (1955) proposed that splitting of air-bubbles in water occurs for:

$$\frac{\rho_w v'^2 \phi_a}{2\sigma} > We_c \qquad \textbf{(A-23)}$$

where σ is the surface tension between air and water, ϕ_a is the bubble diameter, v'^2 is the spatial average value of the square of the velocity differences over a distance equal to ϕ_a and We_c is the critical Weber number for bubble splitting. Experimental results indicate that the critical Weber number has a value close to unity (see Table A-3).

Table A-3 Critical Weber number for splitting of air-bubbles in water flow

Reference	We_c	Fluid	Flow Situation	Comments
HINZE (1955)	0.585		Two co-axial cylinders, the inner one rotating	Dimensional analysis. Reanalysis of the data of CLAY (1940)
SEVIK and PARK (1973)	1.26	Air-bubbles in water	Circular water jet discharging vertically	Experimental data. V in the range 2.1 to 4.9m/s
KILLEN (1982)	1.017	Air-bubbles in water	Turbulent boundary layer	Experimental data. V in the range 3.66 to 18.3m/s
LEWIS and DAVIDSON (1982)	2.35	Air and Helium bubbles in water and Fluorisol	Circular jet discharging vertically	Experimental data. V in the range 0.9 to 2.2m/s
PANDIT and DAVIDSON (1986)	1.1	Air-bubbles in water	Circular jet discharging vertically	Experimental data. V in the range 0.49 to 1.8m/s
EVANS et al. (1992)	0.60	Air-bubbles in water	Confined plunging water jet	Experimental data. V in the range 7.8 to 15m/s
MIKSIS et al. (1981)	1.615	Bubbles in inviscid incompressible fluid	Uniform flow around a bubble	Numerical calculations. Steady potential flow around a bubble of constant internal pressure.
RYSKIN and LEAL (1984)	0.125 to 1.4	Incompressible gas bubble in a liquid of constant density and viscosity	Steady uni-axial extensional flow	Numerical calculations. We_c a function of Re: $We_c = 0.125$ for $Re = 1$; $We_c = 1.4$ for $Re = \infty$
LEWIS and DAVIDSON (1992)	2.35	Cylindrical bubble surrounded by inviscid liquid	Axi-symmetric shear flow	Theoretical value

Assuming that the maximum bubble diameter is of the same order of magnitude as the Prandtl mixing length (CHANSON 1992), the turbulent fluctuation is equal to $v'^2 = (\phi_m \omega)^2$ where ϕ_m is the maximum bubble size and ω is the vorticity (LEWIS and DAVIDSON 1982). If the longitudinal acceleration term dV/dx is small, then the vorticity will be equal to dV/dz where z is the direction perpendicular to the flow direction.

Equation (A-23) can be rearranged to estimate the maximum bubble size in a turbulent shear flow as:

$$\textbf{(A-24)} \qquad \phi_m = \sqrt[3]{\frac{2\sigma We_c}{\rho_w \left(\frac{dV}{dz}\right)^2}}$$

It must be noted that Equations (A-23) and (A-24) above are based on the assumption that there exists a critical bubble size, above which the bubble will be split into smaller fragments by shear forces within the fluid. Such a condition may be expected where bubbles are subjected to a steady shear stress only. In a complex, turbulent air-water mixture, other factors, such as unsteady forces and bubble collisions, will also influence the bubble size.

A.3.2 <u>Specific Interface Area</u>

The surface area of the interface between air and water per unit volume of the air-water mix is called the specific interface area, a. Assuming that the air-water mix consists of spherical air-bubbles or water-droplets of uniform diameter ϕ_a and ϕ_w respectively, the specific interface area may be estimated as:

$$\textbf{(A-25)} \qquad a = \frac{6\,C}{\phi_a} \quad \text{(Air-bubbles in water)} \qquad \text{or} \qquad a = \frac{6\,(1-C)}{\phi_w} \quad \text{(Water-droplets in air)}$$

Intrusive probes such as conductivity or optical-fibre probes measure chord-length data[b] as opposed to bubble diameter. HERRINGE and DAVIS (1976) developed a method for estimating the bubble diameter distribution from the chord-length distribution based on the probability of a probe piercing a spherical bubble at a location relative to the central diameter. This was simplified by LIU and BANKOFF (1993) to give:

$$\textbf{(A-26)} \qquad \phi_{NMS} = 1.5\int_0^{\infty} ch_a \ \Pr(ch_a)\ dch_a = 1.5(ch_a)_{mean}$$

where ϕ_{NMS} is the number mean bubble size and $\Pr(ch_a)$ is the probability of a chord-length of ch_a occurring in the sample.

---

[b] The intrusive probe typically detects air-water interfaces along a line parallel to the flow direction. A 'chord-length' is the length between successive interfaces. If the probe passes through the exact centreline of a spherical bubble, the chord-length detected is equal to the bubble diameter.

Equation (A-25) and (A-26) can be combined to yield:

(A-27) $$a = \frac{4\,C}{(ch_{\mathrm{a}})_{\mathrm{mean}}} = \frac{4\,(1 - \mathrm{C})}{(ch_{\mathrm{w}})_{\mathrm{mean}}} = \frac{4\,F_{\mathrm{a}}}{V}$$

where $(ch_{\mathrm{a}})_{\mathrm{mean}}$ and $(ch_{\mathrm{w}})_{\mathrm{mean}}$ are the average air-bubble and water-droplet chord-lengths detected by the probe, C is the local time-average air concentration, F_{a} is the bubble frequency detected by the probe and V is the velocity of the air-water flow past the probe.

Equation (A-27) is valid only for uniform, spherical bubbles or water-droplets. In a complex multiphase flow region, the specific interface area is simply proportional to the number of air-water interfaces per unit length of air-water mixture:

(A-28) $$a \propto \frac{2\,F_{\mathrm{a}}}{V} \qquad \text{or} \qquad a = K\,\frac{2\,F_{\mathrm{a}}}{V}$$

where K is a function of the shape of the air and water structures. For simplicity, it is often convenient to assume a coefficient of proportionality of K = 2 everywhere. Using this assumption, Equation (A-27) can be used to calculate the specific interface area for any air concentration or bubble size distribution.

For open channel flow, it is possible to obtain a conservative estimate of the specific air-water interface area from Equation (A-25), using an appropriate model from Section A.2 for the air-concentration distribution and assuming that $\phi_{\mathrm{a}} \approx \phi_{\mathrm{m}}$. Assuming that the velocity profile may be approximated as a power law, the maximum bubble size, ϕ_{m}, can be calculated from Equation (A-24) as:

(A-29) $$\phi_{\mathrm{m}} = \sqrt[3]{2 n^2\,\frac{We_{\mathrm{c}}}{We_{\mathrm{e}}}\left(\frac{z}{z_{90}}\right)^{\frac{2(n-1)}{n}}}$$

where We_{c} is the critical Weber number for bubble splitting (Section A.3.1) and We_{e} is the self-aerated flow Weber number, given as:

(A-30) $$We_{\mathrm{e}} = \rho_{\mathrm{w}}\,\frac{V_{90}^2\,z_{90}}{\sigma}$$

where z_{90} and V_{90} are the flow depth and characteristic velocity corresponding to C = 90%.

Despite the crudity of these assumptions, CHANSON (1997a) showed that Equation (A-25) gave a reasonable approximation for the specific interface area when compared with experimental data.

A.3.3 Gas Transfer

Figure A-2 shows the concentration gradient of a chemical at an air-water boundary, where C_a and C_w are the mass concentrations of the chemical in air and water respectively. Fick's First Law of Diffusion states that the mass transfer rate of a chemical across an interface is a function of the concentration gradient at the interface. The ratio of air to water concentrations at equilibrium is equal to the dimensionless Henry's Law constant, *H*.

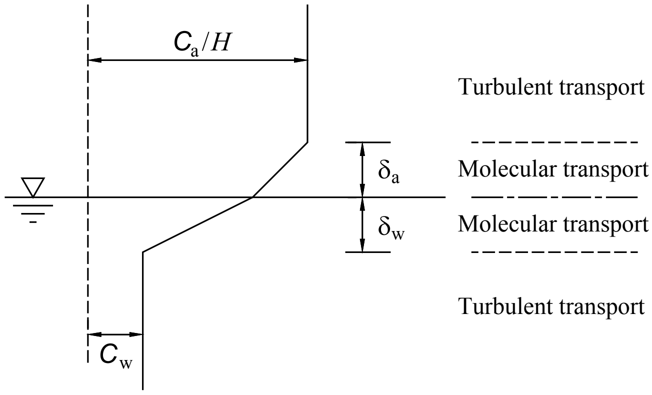


Figure A-2 Concentration gradient at an air-water interface

At a gas-liquid interface in a quiescent fluid, the mass transfer rate of a gas across the interface is a function of the coefficient of molecular diffusion, D_{gas}, and the gradient of gas concentration:

(A-31) $$\frac{\partial M_{gas}}{\partial t} = D_{gas} A \frac{\partial C_{gas}}{\partial x}$$

where C_{gas} is the concentration of the dissolved gas in the liquid and *A* is the gas-liquid interface area (GULLIVER 1990).

If the solute is a volatile gas in liquid (e.g. oxygen, chlorine in water), the transfer is controlled by the liquid phase and the equation for gas transfer may be rewritten as:

(A-32) $$\frac{\partial C_{gas}}{\partial t} = K_L a \left(C_{SAT} - C_{gas}\right)$$

where K_L is the mass transfer coefficient or liquid film coefficient, *a* is the specific interface area (air-water surface area per unit volume of air and water) and C_{SAT} is the concentration of dissolved gas in water at equilibrium (GULLIVER 1990). If the coefficient of transfer, K_L, the specific interface area, *a*, and the velocity, *V*, are known at each location (*x,y,z*) along a streamline, Equation (A-32) yields:

(A-33) $$\frac{dC_{gas}(x,y,z)}{ds} = \frac{K_L(x,y,z)\, a(x,y,z)}{V(x,y,z)} \left(C_{SAT}(x,y,z) - C_{gas}(x,y,z)\right)$$

where *s* is the distance along a streamline.

The dissolved gas concentration can be calculated by integrating Equation (A-33), yielding:

(A-34) $$C_{\text{gas}} = C_{\text{US}} + \left(C_{\text{SAT}} - C_{\text{US}}\right)\left(1 - \exp\left(-\int \frac{K_{\text{L}}\,\overline{a}}{\overline{V}}\,ds\right)\right)$$

where C_{US} and C_{SAT} are the initial (upstream) and saturation dissolved gas concentrations, K_{L} is the coefficient of mass transfer, $\overline{a}$ and $\overline{V}$ are the cross-sectional average specific interface area and velocity, and s is the distance along the structure.

The total aeration potential of a structure may be defined in terms of the deficit ratio, r:

(A-35) $$r = \frac{C_{\text{SAT}} - C_{\text{US}}}{C_{\text{SAT}} - C_{\text{DS}}} \qquad = \exp\left(\int \frac{K_{\text{L}}\,\overline{a}}{\overline{V}}\,ds\right)$$

where C_{US} and C_{DS} are the upstream and downstream dissolved gas concentrations respectively. An alternative measurement is the aeration efficiency, E:

(A-36) $$E = \frac{C_{\text{DS}} - C_{\text{US}}}{C_{\text{SAT}} - C_{\text{US}}} \qquad = 1 - \frac{1}{r} \qquad = 1 - \exp\left(-\int \frac{K_{\text{L}}\,\overline{a}}{\overline{V}}\,ds\right)$$

Assuming two-dimensional flow, $\overline{V}$ and $\overline{a}$ can be calculated as:

(A-37) $$\overline{V} = \frac{q}{d} = \frac{\int_0^{z_{90}} V(1-C)\,dz}{\int_0^{z_{90}} (1-C)\,dz}$$

(A-38) $$\overline{a} = \frac{1}{z_{90}}\int_0^{z_{90}} \frac{6\,C}{\phi}\,dz \qquad \text{or} \qquad \overline{a} = \frac{1}{z_{90}}\int_0^{z_{90}} \frac{4\,F_{\text{a}}}{V}\,dz$$

where C, V and F_{a} are respectively the time-average (undissolved) air concentration, velocity and bubble frequency. As a first approximation for a smooth chute, C and ϕ can be calculated using models detailed in Sections A.2 and A.3.2 respectively.

A.3.3.1 Dissolved Gas Saturation Concentration

The dissolved gas saturation concentration of a liquid, C_{SAT}, is a function of temperature, pressure and salinity. For most practical situations, variations of temperature, salinity and pressure are small, and C_{SAT} may be assumed to be constant. BOWIE et al. (1985) gives the solubility of oxygen in water at equilibrium with water saturated air at standard pressure (1atm.), $C_{\text{SAT}}(P_{\text{std}})$, as:

(A-39)
$$\ln\left(C_{SAT}(P_{std})\right) = -146.25187 + \frac{1.575701\times10^5}{T_K} - \frac{6.642308\times10^7}{T_K^2} + \frac{1.2438\times10^{10}}{T_K^3} - \frac{8.621949\times10^{11}}{T_K^4} - \left(3.1929\times10^{-2} - \frac{19.428}{T_K} + \frac{3.8673\times10^3}{T_K^2}\right) Chl$$

where T_K is the temperature in Kelvin and *Chl* is the chlorinity of the water in parts per thousand (ppt). The chlorinity is defined in relation to the salinity of the water, *Sal*, as:

(A-40) $$Sal = 1.80655\,Chl$$

The saturation concentration for oxygen in water at non-standard pressure, $C_{SAT}(P)$, may be calculated as:

(A-41) $$C_{SAT}(P) = C_{SAT}(P_{std})\left(\frac{(P-P_v)(1-Teta\,P)}{(1-P_v)(1-Teta)}\right)$$

where P is the absolute pressure in atmospheres ($0 < P < 2$atm), P_v is the partial pressure of water vapour in atm., and the coefficient *Teta* is a function of the temperature. The partial pressure of water vapour, P_v and the coefficient *Teta* are both functions of temperature only, and may be approximated as:

(A-42) $$\ln(P_v) = 11.8571 - \frac{3840.70}{T_K} - \frac{216961}{T_K^2}$$

(A-43) $$Teta = 6.7951\times10^{-5} + 2.0901\times10^{-5}\,T_K - 6.436\times10^{-8}\,T_K^2$$

where T_K is the temperature in degrees Kelvin.

A.3.3.2 Coefficient of Mass Transfer

A review of correlations for measured coefficients of mass transfer in turbulent shear flows, K_L, by KAWASE and MOO-YOUNG (1992) revealed that K_L is almost constant regardless of bubble size and flow situation. The transfer coefficient of gas bubbles affected by surface active impurities can be correlated as:

(A-44) $$K_L = 0.28\,D_{gas}^{2/3}\left(\frac{\mu_w}{\rho_w}\right)^{-1/3}\sqrt[3]{g} \qquad (\phi_a < 0.25\text{mm})$$

(A-45) $$K_L = 0.47\sqrt{D_{gas}}\left(\frac{\mu_w}{\rho_w}\right)^{-1/6}\sqrt[3]{g} \qquad (\phi_a > 0.25\text{mm})$$

where D_{gas} is the molecular diffusivity, μ_w and ρ_w are the dynamic viscosity and density of the liquid, g is the gravity constant and ϕ_a is the diameter of the gas bubble.

The gas-liquid diffusivity, D_{gas}, for oxygen and nitrogen in water can be correlated from the data of FERRELL and HIMMELBLAU (1967) as:

(A-46) $$D_{gas}(O_2) = 1.16793 \times 10^{-27} T_K^{7.3892}$$

(A-47) $$D_{gas}(N_2) = 5.567 \times 10^{-11} T_K - 1.453 \times 10^{-8}$$

where T_K is the temperature in Kelvin.

APPENDIX B – VELOCITY PROFILE IN A FREE JET

B.1 CONSERVATION OF MOMENTUM

Consider a homogenous water jet discharging into stagnant air. The velocity of air at the air-water interface must be equal to the velocity of the water, and hence the passage of water jet must mobilise a layer of air above and below the jet. Since there are no external forces acting on the system, there must be a transfer of momentum from the water jet to maintain the motion of the air layer. The momentum gained by the surrounding air is equal to the momentum lost by the jet, therefore:

(B-1) $$\rho_a q_a \Delta V_a = -\rho_w q_w \Delta V_w$$

Given that the air starts at rest and has a final velocity equal to that of the water, the change in velocity of the water jet may be calculated as:

(B-2) $$\Delta V_w = \left(\frac{\rho_w q_w}{\rho_w q_w + \rho_a q_a} - 1 \right) V_{w0}$$

where V_{w0} is the initial velocity of the water jet and ΔV_w is the change in velocity of the jet.

For a *real* fluid with non-zero viscosity, a boundary layer exists in the water jet upstream of the step brink. Figure B-1 shows a series of typical velocity profiles through a free-falling water jet. The velocity profile within the boundary layer upstream of the step brink is non-uniform, decreasing to zero at the invert. The velocity distribution changes downstream of the step brink, becoming more uniform as the distance from the step brink increases.

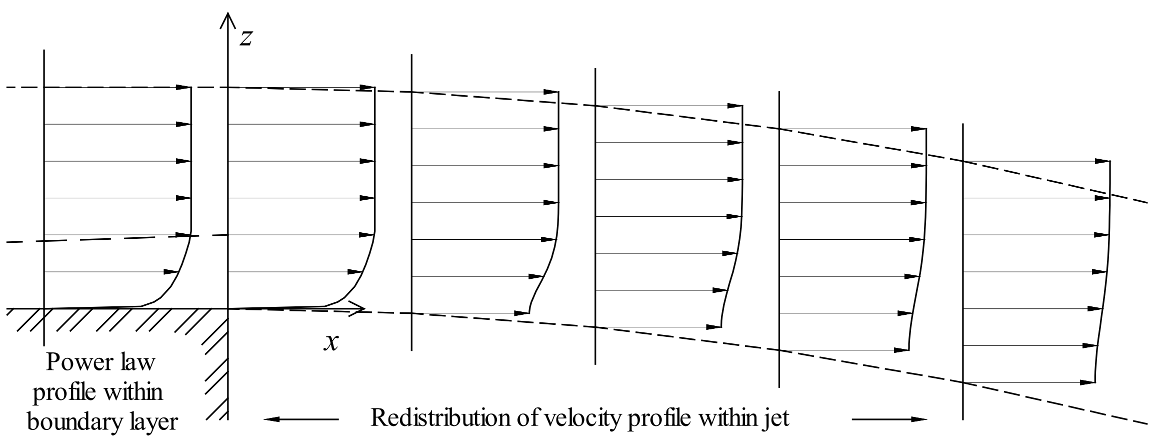


Figure B-1 Velocity profile through a homogenous two-dimensional jet discharging into air

One potential solution for the velocity profile through a water jet discharging into air is to use the same solution as for a monophase jet (i.e. a water jet discharging over a stagnant pool of water) (CHANSON 1993b, 1996). However, the monophase jet model implies that there is a significant transfer of momentum from the moving jet to the stagnant air.

DODU (1957) found that the thickness of the mobilised air layer is relatively small. If it is assumed that the volume of air mobilised is of similar magnitude to the volume of water, then the relative density of air to water implies that the change in the water jet velocity is minimal (Equation (B-2) → $\Delta V_w / V_{w0} < 0.2\%$). The loss of momentum from the water jet is therefore negligible. Experimental measurements of the flowrate, q_w, and the momentum flux, J_w, along the centreline of a free-falling jet are presented in Table B-1. Although there is some fluctuation of the water flowrate along the jet centreline, probably due to three-dimensional patterns of the jet, both the flowrate and the momentum flux remain relatively constant along the jet (within the accuracy of the instrumentation and calculations). There is no significant loss of momentum from the water jet. This suggests that a monophase jet model is inappropriate for a water jet discharging into air.

Table B-1 Comparison of water flowrate and momentum flux along a jet centreline
Exp. DT3, $d_0 = 29.6$mm, $V_0 = 3.75$m/s

Distance X	**Depth** $d = \int (1-C)\, dz$	**Flowrate** $q_w = \int V(1-C)\, dz$	**Momentum Flux** $J = \int V^2(1-C)\, dz$
[m]	**[m]**	**[m²/s]**	**[m³/s²]**
0.000	0.0297	0.112	429.1
0.025	0.0297	0.113	429.2
0.050	0.0288	0.107	397.7
0.100	0.0295	0.112	422.9
0.200	0.0292	0.112	427.1
0.300	0.0281	0.109	424.3

If the transfer of momentum from the jet to the air has a negligible effect on the water jet, what causes the variation of the velocity profile observed along the jet? The velocity profile within the turbulent boundary layer upstream of the drop is a function of friction between the water and the step invert, and internal friction in the fluid: i.e. the non-slip condition at the invert implies a shearing force is exerted on and through the fluid. This shear force is suddenly removed downstream of the step brink, resulting in a momentum flux imbalance within the jet. This leads to a modification of the velocity profile along the jet. The purpose of this section is to find an appropriate solution that can accurately model the velocity profile redistribution.

B.2 EQUATIONS OF MOTION

The Navier-Stokes equations in the Cartesian system are written for a two-dimensional plane turbulent free-jet as (SCHLICTING 1968, Chapter 18):

(B-3) $$\frac{\partial V_x}{\partial t} + V_x \frac{\partial V_x}{\partial x} + V_z \frac{\partial V_x}{\partial z} = -\frac{1}{\rho}\frac{\partial P}{\partial x} + \nu\left(\frac{\partial^2 V_x}{\partial x^2} + \frac{\partial^2 V_x}{\partial z^2}\right) - \left(\frac{\partial \overline{V'^2_x}}{\partial x} + \frac{\partial \overline{V'_x V'_z}}{\partial z}\right)$$

(B-4) $$\frac{\partial V_z}{\partial t} + V_x \frac{\partial V_z}{\partial x} + V_z \frac{\partial V_z}{\partial z} = -\frac{1}{\rho}\frac{\partial P}{\partial z} + \nu\left(\frac{\partial^2 V_z}{\partial x^2} + \frac{\partial^2 V_z}{\partial z^2}\right) - \left(\frac{\partial \overline{V'_x V'_z}}{\partial x} + \frac{\partial \overline{V'^2_z}}{\partial z}\right)$$

where the x-axis is in the axial direction of the jet and the z-axis is normal to the x-axis and is in the direction of the height of the nozzle. V_x, V_z, V'_x and V'_z are the turbulent mean and fluctuating velocities in the x and z coordinate directions, P is the mean pressure at any point, ρ is the mass density, ν is the kinematic viscosity and t is the time variable.

The equations may be simplified using the following assumptions:

- **The mean flow is steady**: the average velocities of the flow are constant with time, therefore $\partial V_x/\partial t = 0$ and $\partial V_z/\partial t = 0$;
- **The transverse extent of the flow is small**: V_x is generally much larger than V_z in a large portion of the jet, while velocity and stress gradients in the z-direction are much larger than those in the x-direction;
- **Laminar shear stresses are negligible**: in free turbulent flows, the laminar shear stresses, τ_l, are much smaller than the turbulent shear stresses, τ_t, because of the absence of solid boundaries; and
- **The axial pressure gradient is negligible**: in a large number of problems, the pressure gradient in the axial direction is negligibly small, hence $\partial P/\partial x \approx 0$.

Based on these assumptions, Equations (B-3) and (B-4) become:

(B-5) $$V_x \frac{\partial V_x}{\partial x} + V_z \frac{\partial V_x}{\partial z} = \frac{1}{\rho}\frac{\partial \tau_t}{\partial z}$$

while the continuity equation for an incompressible fluid may be written as:

(B-6) $$\frac{\partial V_x}{\partial x} + \frac{\partial V_z}{\partial z} = 0$$

B.3 ANALYTICAL SOLUTIONS

B.3.1 Free Jet Boundary (Monophase Flow)

A jet discharging into air was previously modelled using a monophase flow solution (CHANSON 1993b, 1996). At x = 0, a plane jet of large (or semi-infinite) height leaves the edge of a deflection. It passes over a stagnant mass **of the same fluid**. The shear force at the velocity discontinuity causes the stagnant fluid to be accelerated, while momentum is transferred from the jet.

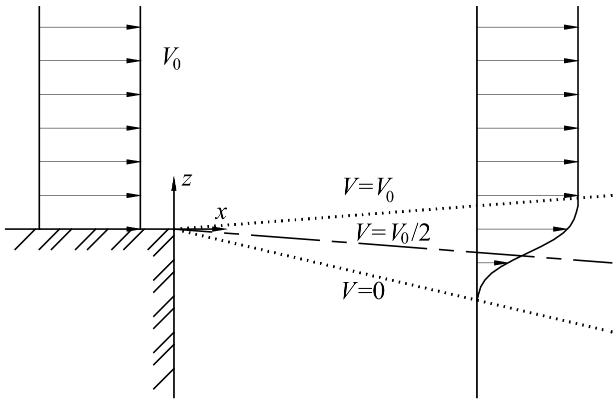


Figure B-2 Definitions for a monophase shear layer

B.3.1.1 GOERTLER's solution

The characteristics of monophase shear layers were analysed in the 1920's and 1930's using mixing length theory. GOERTLER (1942) used the second equation of Prandtl to predict the turbulent shear stress as:

(B-7) $$\tau = \rho \nu_t \frac{\partial V_x}{\partial z}$$

where ν_t is a momentum exchange coefficient, also called the virtual kinematic viscosity or eddy viscosity. ν_t is independent of z, and is calculated as:

(B-8) $$\nu_t = \chi_1 b (V_{max} - V_{min})$$

where χ_1 is an empirical constant, V_{max} and V_{min} are the free-stream velocities at the upper and lower boundaries of the mixing layer, and b is the width of the mixing layer. The equation of motion, Equation (B-5), becomes:

(B-9) $$V_x \frac{\partial V_x}{\partial x} + V_z \frac{\partial V_x}{\partial z} = \chi_1 b (V_{max} - V_{min}) \frac{\partial^2 V_x}{\partial z^2}$$

For a free jet boundary, SCHLICHTING (1979) showed that width of the mixing layer is proportional to the distance from the brink, $b = cx$, where c is a constant. The maximum and minimum velocity are $V_{max} = V_0$ and $V_{min} = 0$. Equation (B-9) can therefore be written as:

(B-10) $$V_x \frac{\partial V_x}{\partial x} + V_z \frac{\partial V_x}{\partial z} = \chi_1 c\, x\, V_0 \frac{\partial^2 V_x}{\partial z^2}$$

The velocity vector, $\vec{V}$, and the stream function, $\vec{\psi}$, are related as $\vec{V} = -\overrightarrow{\text{curl}}\,\vec{\psi}$, where $\vec{V}$ = (V_x, V_z, 0), and $\vec{\psi}$ = (0, 0, ψ), then:

$$\textbf{(B-11)} \qquad V_x = -\frac{\partial \psi}{\partial z} \qquad V_z = \frac{\partial \psi}{\partial x}$$

By introducing a change of variable, ξ, where $\xi = \sigma \frac{x}{z}$ and σ is a constant to be defined later, and adopting a stream function ψ as a function of ξ such that:

$$\psi = -x \frac{V_0}{2} F(\xi)$$

then Equation (B-11) can be used to develop the relationships:

$$\textbf{(B-12)} \qquad V_x = \sigma \frac{V_0}{2} F'(\xi) \qquad V_z = \xi \frac{V_0}{2} F'(\xi) - \frac{V_0}{2} F(\xi)$$

Differentiating Equation (B-12) and substituting into Equation (B-5), the equation of motion becomes:

$$\textbf{(B-13)} \qquad -\frac{\sigma^2}{x} \frac{V_0}{4} F\, F'' = \chi_1 c \frac{V_0}{4} \frac{\sigma^3}{x} F'''$$

Assuming that $\frac{\sigma^2}{x} \frac{V_0}{4} \neq 0$ and if the constant σ is defined as $\sigma = \frac{1}{2} \frac{1}{\sqrt{\chi_1 c}}$ then the equation becomes:

$$\textbf{(B-14)} \qquad F''' + 2\sigma^2 F\, F'' = 0$$

In the first approximation, the solution of Equation (B-14) was obtained by RAJARATNAM (1976) and SCHLICHTING (1979) as:

$$\textbf{(B-15)} \qquad \frac{V_x}{V_0} = \frac{1}{2}\left(1 + erf\left(\frac{K(z - z_{V50})}{x}\right)\right)$$

where V_0 is the mainstream velocity, z_{V50} is the location where $V_x = V_0/2$, K is a constant and the function *erf* is defined as:

$$erf(u) = \frac{2}{\sqrt{\pi}} \int_0^u \exp\left(-t^2\right) dt$$

The constant K derives from the assumption of a constant eddy viscosity ν_t across the shear layer:

(B-16) $$\nu_t = \frac{1}{4K^2} V_0 x$$

Although the monophase model was applied to a water jet discharging into air by CHANSON (1993b, 1996), the model implies a significant transfer of momentum from the moving water jet to the stagnant gas. Experimental results from the current study and a reanalysis of the data of CHANSON and BRATTBERG (1997) suggest that the loss of momentum in a water jet discharging into air is negligible because of the large density difference between air and water. This finding is consistent with the experimental data of DODU (1957).

B.3.2 Wake Flow (New Model)

When the transfer of momentum from the water jet to the surrounding air is negligible, the shear force and consequently the velocity gradient $\partial V/\partial z$ at the air-water interface of the jet must be approximately equal to zero.

The situation resembles a wake flow behind a bluff body (Figure B-3). Considering the wake flow behind a thin splitter plate, the shear force and velocity gradient along the centreline are equal to zero due to the symmetry of the flow.

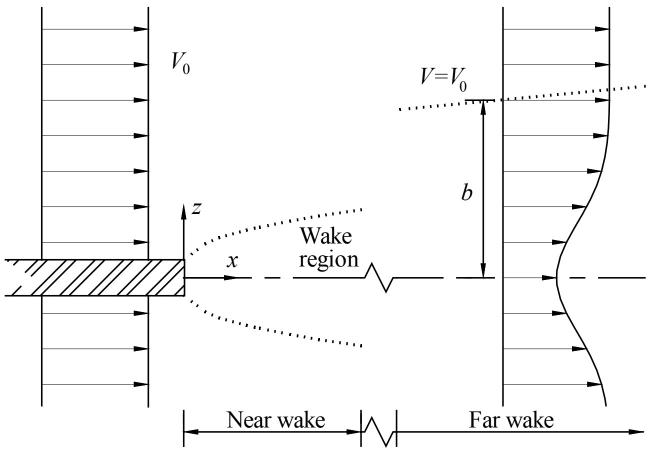


Figure B-3 Definitions for the wake flow model

Analysis of the velocity profile close to the bluff body ('near wake' region, Figure B-3) is complex, and a review of current literature suggests that there is no simple analytical solution within the near wake region (ref: TENNEKES and LUMLEY 1972, SCHLICHTING 1979, SCHETZ 1993). At a sufficiently large distance downstream of the body ('far wake' region), the centreline velocity is approximately equal to the mainstream velocity ($V_0 - V_x \approx V_0$) and analytical solutions may be developed based on this assumption.

B.3.2.1 REICHARDT's Solution (Wake Flow)

REICHARDT (1951) developed a solution for wake flow using Prandtl's mixing length hypothesis, which states that:

(B-17) $$\tau = \rho l^2 \left| \frac{\partial V_x}{\partial z} \right| \frac{\partial V_x}{\partial z}$$

where l is the mixing length. Assuming that $V_x \approx V_0$ and $V_z \frac{\partial V_x}{\partial z} \approx 0$, Equation (B-5) can be written as:

(B-18) $$-V_0 \frac{\partial V'_x}{\partial x} = 2l^2 \frac{\partial V'_x}{\partial z} \frac{\partial^2 V'_x}{\partial z^2}$$

where $V'_x = V_0 - V_x$. The mixing length, l is assumed to be constant over the width of the mixing layer, b and proportional to it, i.e. $l = \beta b(x)$, where β is a constant. SCHLICHTING (1979) showed that in the far wake region (i.e. $V_0 - V_x \approx V_0$) for a two-dimensional wake in turbulent flow behind a cylinder of diameter d, the mixing layer thickness $b \propto x^{1/2}$, while the difference between the mainstream and centreline velocities $(V_{max} - V_{min}) \propto x^{-1/2}$. The following assumptions can be therefore made:

(B-19) $$b = B\sqrt{c_d d\, x}$$

(B-20) $$V'_x = V_0 \sqrt{\frac{c_d d}{x}} F\left(\frac{z}{b}\right)$$

where d and c_d are the diameter and drag coefficient of the cylinder and B is a constant.

Inserting into Equation (B-18) leads to the differential equation:

(B-21) $$\frac{1}{2}\left(F + \frac{z}{b}F'\right) = \frac{2\beta^2}{B} F' F''$$

where $F = F\left(\frac{z}{b}\right)$ etc.. The constant B may be determined from integration of the momentum equation as $B = \sqrt{10}\beta$.

Applying the boundary conditions $V'_x(z = b) = 0$ and $\frac{\partial V'_x}{\partial z}(z = 0) = 0$, the final solution to this differential equation is:

(B-22) $$\frac{V_x}{V_0} = 1 - \frac{\sqrt{10}}{18\beta}\sqrt{\frac{c_d d}{x}}\left(1 - \left(\frac{z}{b}\right)^{3/2}\right)^2$$

where β is a constant. The width of the mixing layer, b, is given by:

(B-23) $$b = \sqrt{10}\beta (c_d d\, x)^{1/2}$$

It should be noted that Equation (B-22) is an approximation for large distances of x, with measurements by SCHLICHTING (1979) indicating that it is accurate for $x/c_d d > 50$.

B.3.2.2 GOERTLER's Solution (Wake Flow)

GOERTLER (1942) used the second equation of Prandtl to predict the turbulent shear stress as:

(B-24) $$\tau = \rho \nu_t \frac{\partial V_x}{\partial z}$$

where ν_t is the eddy viscosity independent of z, given as

(B-25) $$\nu_t = \chi_1 b (V_{max} - V_{min})$$

where χ_1 is an empirical constant, V_{max} and V_{min} are the free-stream velocities at the upper and lower boundaries of the mixing layer and b is the width of the mixing layer.

In the far wake region of a two-dimensional wake in turbulent flow, the mixing layer thickness becomes $b \propto x^{1/2}$, and $(V_{max} - V_{min}) \propto x^{-1/2}$ (SCHLICHTING 1979). It can consequently be shown that the eddy viscosity ν_t is independent of distance.

(B-26) $$\nu_t = \chi_1 b (V_{max} - V_{min}) = \chi_1 c_1 \sqrt{x} \frac{c_2}{\sqrt{x}} = \text{constant}$$

Assuming that $V_x \approx V_0$ and that $V_z \frac{\partial V_x}{\partial z} \approx 0$, Equation (B-9) may be approximated as:

(B-27) $$V_0 \frac{\partial V_x}{\partial x} = \nu_t \frac{\partial^2 V_x}{\partial z^2}$$

This is a simple linear partial differential equation with the boundary conditions of $V_x(z \to \infty) = V_0$ and $\frac{dV_x}{dz}(z = 0) = 0$. The solution of Equation (B-27) has been presented by a number of authors, including TENNEKES and LUMLEY (1972), SCHLICHTING (1979), and ROIG (1993). The solutions presented in the various texts are virtually identical, differing only in the definition of the constants. Perhaps the most straightforward definition is that proposed by SCHETZ (1993):

(B-28) $$\frac{V_x}{V_0} = 1 - \frac{C}{\sqrt{x}} \exp\left(-\frac{V_0 z^2}{4 \nu_t x}\right)$$

where ν_t is the eddy viscosity and C is an integration constant determined to satisfy continuity, $q = \int_{-\infty}^{\infty} V_x \, dz = \text{constant}$.

B.3.3 Application of Wake Flow Solutions to a Free Jet

Consider a free jet of semi-infinite thickness, *d*, discharging into a void. It is assumed that a partially developed boundary layer of thickness δ_{99} exists on the step upstream. The velocity profile within the boundary layer may be approximated by a power law[a], while the velocity outside the boundary layer is uniform:

(B-29)
$$\frac{V_x(z)}{V_0} = \begin{cases} \left(\dfrac{z}{\delta_{99}}\right)^{1/n} & z < \delta_{99} \\ 1 & z \geq \delta_{99} \end{cases}$$

B.3.3.1 Constants for GOERTLER's Solution (Wake Flow model)

Although there are no external forces acting on the jet, the momentum flux will reduce slightly along the jet due to turbulent diffusion. Conservation of mass states that, for an incompressible fluid, the flowrate along the jet must be constant. Assuming a velocity distribution as given by Equation (B-29), the flowrate just upstream of the step brink for a jet of semi-infinite thickness, *d*, is equal to:

(B-30)
$$q = \int_0^d V_x \, dz \qquad = \int_0^{\delta_{99}} V_0 \left(\frac{z}{\delta_{99}}\right)^{1/n} dz + \int_{\delta_{99}}^{d} V_0 \, dz$$
$$= V_0 \left(d - \frac{\delta_{99}}{1+n}\right)$$

where δ_{99} is the boundary layer thickness and *n* is the power law factor.

Using the equation for GOERTLER's solution proposed by SCHETZ (1993) (Equation (B-28)), the flowrate at a distance *x* from the step brink may be calculated as:

(B-31)
$$q = \int_0^d V_x \, dz \qquad = V_0 \int_0^d 1 - \frac{C}{\sqrt{x}} \exp\left(-\frac{V_0 z^2}{4 \nu_t x}\right) dz$$
$$= V_0 \left(d - C\sqrt{\frac{\pi \nu_t}{V_0}}\right)$$

---

[a] A number of different assumptions for the velocity profile in a turbulent boundary layer exist, including a '*law of the wake*' (COLES 1956). In engineering practice, the velocity profile is often approximated as a power law function. This is discussed in detail in Section B.5.2.

By continuity, Equations (B-30) and (B-31) must be equal, hence:

(B-32) $$C\sqrt{\frac{\pi \nu_t}{V_0}} = \frac{\delta_{99}}{1+n}$$

At the lower interface (or centreline for wake flow), z = 0, and Equation (B-28) may be written as:

(B-33) $$\frac{V_{cl}}{V_0} = 1 - \frac{C}{\sqrt{x'}} \qquad \text{or} \qquad V_0 - V_{cl} = \frac{C\,V_0}{\sqrt{x'}}$$

Substituting into Equation (B-26) yields:

(B-34) $$\begin{aligned}\nu_t &= \chi_1 c \sqrt{x}(V_0 - V_{cl}) \\ &= \chi_1 c\, V_0 C\end{aligned}$$

where $\chi_1 c$ is a constant.

Equating Equations (B-32) and (B-34) returns:

(B-35) $$C = \left(\frac{\delta_{99}}{1+n}\frac{1}{\sqrt{\pi \chi_1 c}}\right)^{2/3}$$

B.3.3.2 Constants for REICHARDT's Solution (Wake Flow Model)

As with GOERTLER's solution, continuity states that the flowrate must be constant along the jet. Using the equation for REICHARDT's solution proposed by SCHLICHTING (1979), Equation (B-22), the flowrate at a distance x from the step brink is:

(B-36) $$\begin{aligned} q = \int_0^d V_x\, dz \qquad &= V_0 \int_0^b 1 - \frac{\sqrt{10}}{18\beta}\sqrt{\frac{c_d d}{x}}\left(1 - \left(\frac{z}{b}\right)^{3/2}\right) dz + \int_b^d V_0\, dz \\ &= V_0\left(d - \frac{c_d d}{4}\right)\end{aligned}$$

Assuming no change in momentum flux, Equations (B-30) and (B-36) must be equal, hence:

(B-37) $$\frac{c_d d}{4} = \frac{\delta_{99}}{1+n}$$

or:

(B-38) $$c_d d = \frac{4\delta_{99}}{1+n}$$

There is no simple relationship linking $c_d d$ and β to $\chi_1 c$ and V_0 since REICHARDT's solution and GOERTLER's solution are based on different assumptions for the turbulent shear stress. However, if the two solutions are equated at $z = 0$, Equations (B-22) and (B-28) combine to form:

(B-39) $$\frac{\sqrt{10}}{18\beta}\sqrt{\frac{c_d d}{x}} = \frac{C}{\sqrt{x}}$$

Substituting Equations (B-35) and (B-38) yields:

(B-40) $$\beta = \frac{\sqrt{10}}{9}(\pi\chi_1 c)^{1/3}\left(\frac{1+n}{\delta_{99}}\right)^{1/6}$$

It must be noted that this equates GOERTLER's and REICHARDT's solution at z = 0 only.

B.4 NUMERICAL MODELLING OF THE WATER JET

No simple analytical solution exists for the velocity profile through the free water jet when the inflow conditions are not a uniform velocity distribution. Given that the attributes of the incoming flow and the boundary conditions are known, it is possible to numerically predict changes in the velocity profile with reasonable accuracy, for sufficiently small changes of x and z.

B.4.1 Simplifications and Boundary Conditions

The following assumptions are made in order to simplify the numerical model:

- Since the density of water is significantly greater then the density of air, the free-jet is modelled as a monophase jet ($\rho = \rho_w$) discharging into a void ($\rho_{void} = 0$);
- The boundary between the jet and the void is assumed to remain a discrete interface. The jet remains homogenous and no mixing occurs at the interface (i.e. no jet break-up or entrainment of 'bubbles' into the jet); and
- The width of the mixing layer $b \propto x^{1/2}$ (as for two-dimensional wake flow; SCHLICHTING (1979)). Hence $\nu_t = \chi_1 c\sqrt{x}\left(V_{max} - V_{min}\right)$ and Equation (B-9) may be written as:

(B-41) $$V_x\frac{\partial V_x}{\partial x} + V_z\frac{\partial V_x}{\partial z} = \chi_1 c\sqrt{x}\left(V_{max} - V_{min}\right)\frac{\partial^2 V_x}{\partial z^2}$$

The following boundary conditions are relevant:

- Since there is no shear between the jet and the surrounding void, $\frac{dV_x}{dz} = 0$ at the interface; and
- The flowrate along the jet is constant, i.e. $q = \int_{-\infty}^{\infty} V_x \, dz$ = constant.

B.4.2 The Numerical Model Procedure

The numerical model calculates velocity profiles at a series of intervals along the jet. The model employs the following procedure:

1. Define an initial velocity profile based on the inflow conditions at the step brink (*see Section B.5.2 for an example*).

2. Calculate $\frac{dV_x}{dz}$ and $\frac{d^2V_x}{dz^2}$ from the velocity profile. $\frac{dV_x}{dz}$ = 0 at the upper and lower boundaries of the jet.

3. Equation (B-41) may be written as:

$$\int_{V_{x0}}^{V_{x1}} V_x \, dV_x = \int_{x_0}^{x_1} \chi_1 c \sqrt{x} \left(V_{max} - V_{min}\right) \frac{d^2V_x}{dz^2} - V_z \frac{dV_x}{dz} \, dx$$

   Assuming that $V_z \frac{dV_x}{dz}$, $\frac{d^2V_x}{dz^2}$ and (V_{max} – V_{min}) are constant from x_0 to x_1, the horizontal component of the subsequent velocity profile may be compiled as:

(B-42) $$V_{x1} = \sqrt{V_{x0}^2 + \frac{4}{3}\chi_1 c \left(V_{max} - V_{min}\right) \frac{\partial^2 V_x}{\partial z^2} \left(x_1^{3/2} - x_0^{3/2}\right) - 2V_z \frac{\partial V_x}{\partial z}\left(x_1 - x_0\right)}$$

4. Calculate the vertical component of the subsequent velocity profile, V_z, from the continuity equation:

(B-43) $$\Delta V_z = -\frac{\Delta z}{\Delta x} \Delta V_x$$

5. Repeat steps 2 through 4 for successive intervals. The accuracy of the calculation should be acceptable for sufficiently small values of Δx and Δz.

B.5 EVALUATION OF THE MODELS

B.5.1 Limitations of the Models

Air is entrained at the air-water interfaces of a free-jet discharging into air, particularly the lower interface. The analytical solutions and the numerical model are based on a monophase fluid; i.e. they assume that the fluid remains homogenous. The transfer of momentum to the surrounding air, however slight, is also not included in the model.

The analytical solutions for wake flow of GOERTLER and REICHARDT should provide a good approximation when investigating the velocity redistribution within the jet. The range over which the equations are applicable is limited by the assumptions used to develop the analytical solution:

- **Only applicable in the 'Far Wake'**: The analytical solutions are based on the assumption that the velocity difference, $V'_x = V_0 - V_x$, is small compared with the free stream velocity, V_0. SCHLICHTING (1979) estimates that this assumption is valid for $x/c_d d > 50$; and
- **Infinite Jet Thickness**: The solutions both assume a jet of semi-infinite thickness; that is, the flow depth is greater than the mixing layer thickness, $b < d$.

From these assumptions, Equations (B-23) and (B-38) can be used to predict that the numerical solutions are applicable within the range:

(B-44) $$\frac{200\,\delta_{99}}{(1+n)} \leq x \leq \frac{(1+n)\,d^2}{40\beta^2\delta_{99}}$$

where d is the flow depth, δ_{99} is the boundary layer thickness at the step brink and n is the power law coefficient of the velocity profile within the boundary layer.

A numerical model is required to obtain the velocity profiles in regions outside this range, i.e. in the 'near wake' region or when the mixing layer thickness has reached the upper surface. There are, however, some complications associated with the assumptions made with the numerical model, in particular Equation (B-41), which is based on the assumption that the mixing layer thickness, $b = c\sqrt{x}$. This statement is based on the derivation by SCHLICHTING (1979) and has two obvious discrepancies:

- **Mixing layer growth rate**: The hypothesis that $b \propto \sqrt{x}$ is derived using the assumption that $V_0 - V_x << V_0$, and hence is only valid in the 'far wake' region. Within the near wake region, the growth rate of the mixing layer is unknown; and
- **Origin of the Mixing Layer**: The distance x is defined relative to the location where the mixing layer thickness is equal to zero. At the step brink $b > 0$ because of the upstream boundary layer, so the origin must be some distance upstream of this location.

The Numerical Model may be modified such that it measures its horizontal distance, x_n, from a virtual origin upstream of the step edge:

(B-45) $$x_n = x + \xi_n$$

where x is the distance measured from the step edge and ξ_n is the origin offset. However, since the growth rate of the mixing layer in this location is unknown, it is highly problematical to calculate the exact value of ξ_n. Using the Numerical Model, investigation of the effect of ξ_n on the shape of the velocity profile indicates that the difference between profiles at the same distance from the step brink calculated using different offsets decreases rapidly as x increases, i.e. the effect of ξ_n is only significant close to the step brink.

Approximation of the Origin:

Since the mixing layer thickness is greater than zero at the step brink, both the numerical and analytical solutions must originate from a point upstream of the step brink. Although there is no simple way of calculating the location of the origin for the numerical model, it is possible to make an approximation for the analytical models. For REICHARDT's solution for wake flow, the mixing layer thickness, b, at a distance from the origin is given by Equation (B-23). If it is assumed that the mixing layer thickness at the step edge is equal to the thickness of the turbulent boundary layer, i.e. $b = \delta_{99}$, then the distance from the origin to this location, $x_{b=\delta}$, can be approximated using the estimates for $c_d d$ and β from Equations (B-38) and (B-40) as:

(B-46) $$x_{b=\delta} = \frac{81}{400}\left(\frac{n+1}{\pi \chi_1 c}\right)^{2/3} \left(\delta_{99}\right)^{4/3}$$

It must be noted that $x_{b=\delta}$ can only be used as an approximation for the origin of the analytical solutions, since it assumes that $b = \delta_{99}$ at the step edge and also relies on the assumptions used by REICHARDT's solution remaining true within the near-wake region.

B.5.2 Comparison between Numerical Model and Experimental Results

B.5.2.1 Inflow Conditions

A turbulent boundary layer of thickness δ_{99} is present on the step upstream of the brink. The velocity profile is uniform above the boundary layer, while within the boundary layer the velocity decreases to zero at the step surface. The flow field within a turbulent boundary layer can be divided into three regions:

- The *inner wall region* or 'viscous sublayer', where the turbulent stress is negligible and the viscous stress is large ($z < 10\nu/V_*$, where ν is the fluid kinematic viscosity and V_* is the shear velocity),
- The *outer region*, where the turbulent stress is large and the viscous stress is small ($z > 0.1\delta_{99}$), and
- An overlap region, sometimes called the *turbulent zone*.

A number of different equations exist for the velocity profiles in each of the regions within the boundary layer. These are discussed in greater detail in CHETZ (1993) and CHANSON (1999). The velocity profile within the *turbulent zone* and *outer region* is often represented by the '*law of the wake'* (COLES 1956):

(B-47) $$\frac{V}{V_*} = \frac{1}{\mathrm{K}}\ln\left(\frac{V_* z}{\nu}\right) + D_1 + \frac{\Pi}{\mathrm{K}} Wa\left(\frac{z}{\delta_{99}}\right) \qquad 30 \text{ to } 70 < \frac{V_* z}{\nu}$$

where K is the von Karman constant (K = 0.40), D_1 is a constant, Π is the wake parameter and Wa is COLES' wake function, originally estimated as (COLES 1956):

$$Wa\left(\frac{z}{\delta_{99}}\right) = 2\sin^2\left(\frac{\pi}{2}\frac{z}{\delta_{99}}\right)$$

The velocity profile in a turbulent boundary layer is often approximated by a power law function:

(B-48) $$\frac{V}{V_{max}} = \left(\frac{z}{\delta_{99}}\right)^{1/n}$$

where n is a function of the boundary roughness. For smooth turbulent flows, $n = 7$ (e.g. SCHLICHTING 1979). The power law factor within the boundary layer is found to have a value of $n \approx 6.67$ for the single-step model used in experiments DT1 to DT5.

The power law function only requires a single constant, n, whereas the 'law of the wake' requires three constants, K, D_1 and Π, as well as an entirely separate function for the inner wall region. An investigation using the Numerical Model found that there is little difference in the calculated downstream velocity profiles, regardless of whether the 'law of the wake' (Equation (B-47)) or the power law function (Equation (B-48)) is used to approximate the upstream flow velocity. For simplicity, the upstream velocity profile is consequently approximated using a power law function. The initial velocity profiles may be modelled as:

(B-49)
$$\frac{V_x(z)}{V_0} = \begin{cases} \left(\dfrac{z}{\delta_{99}}\right)^{1/n} & z < \delta_{99} \\ 1 & z \geq \delta_{99} \end{cases}$$
$$V_z(z) = 0$$

B.5.2.2 Selection of Constants

The Numerical Model was used to investigate a range of experimental data from both the current study and CHANSON (1988). The inflow conditions for the Numerical Model were established to represent those found at the step brink for the experimental flow conditions (Table B-2). The Numerical Model requires two factors in addition to the inflow conditions: the constant $\chi_1 c$ used to estimate the eddy viscosity, ν_t, and the location of the virtual origin used for calculating the thickness of the mixing layer, b.

SCHLICHTING (1979) reports that a value of $\beta = 0.18$ was obtained from experiments on the wake behind a circular cylinder. $\chi_1 c$ can be related to β, δ_{99} and n using Equation (B-40). Since β and n are constant, and δ_{99} is relatively constant for all the experimental flow conditions, the value of $\chi_1 c$ remains relatively constant for all the experimental runs. The constants for the analytical models determined using Sections B.3.3.1 and B.3.3.2 are also shown in Table B-2.

As discussed in Section B.5.1, the exact location of the virtual origin is difficult to determine. An arbitrary value of $\xi_n = 0.66 x_{b=\delta}$ was chosen as an estimate. The reasons for this decision are discussed in Section B.5.3. This value is found to have a very limited effect on the velocity profiles downstream of the step brink.

Table B-2 Inflow conditions and constants used by the numerical model

Experiment			DT1[a]	DT2[a]	DT3[a]	DT4[a]	DT5[a]	1050[b]	1051[b]
Uniform velocity, V_0		[m/s]	3.05	3.44	3.91	3.93	3.88	8.50	11.25
Flow depth, d		[m]	0.0306	0.0290	0.0296	0.0243	0.0397	0.0400	0.0400
Boundary layer depth, δ_{99}		[m]	0.0110	0.0102	0.0101	0.0109	0.0099	0.0100	0.0100
Power law factor, n			6.67	6.67	6.67	6.67	6.67	6.67	6.67
Virtual origin offset, ξ_n		[m]	0.043	0.040	0.040	0.042	0.039	0.039	0.039
Eddy viscosity constant, $\chi_1 c$		[m$^{1/2}$]	0.00162	0.00156	0.00155	0.00162	0.00154	0.00155	0.00155
Analytical Model Constants									
GOERTLER's solution:	ν_t	[m²/s]	0.00037	0.00038	0.00043	0.00047	0.00042	0.00093	0.00123
	C	[m$^{1/2}$]	0.0740	0.0710	0.0707	0.0737	0.0702	0.0705	0.0705
REICHARDT's solution:	β		0.18	0.18	0.18	0.18	0.18	0.18	0.18
	$c_d d$	[m]	0.00574	0.00529	0.00525	0.00570	0.00518	0.00522	0.00522

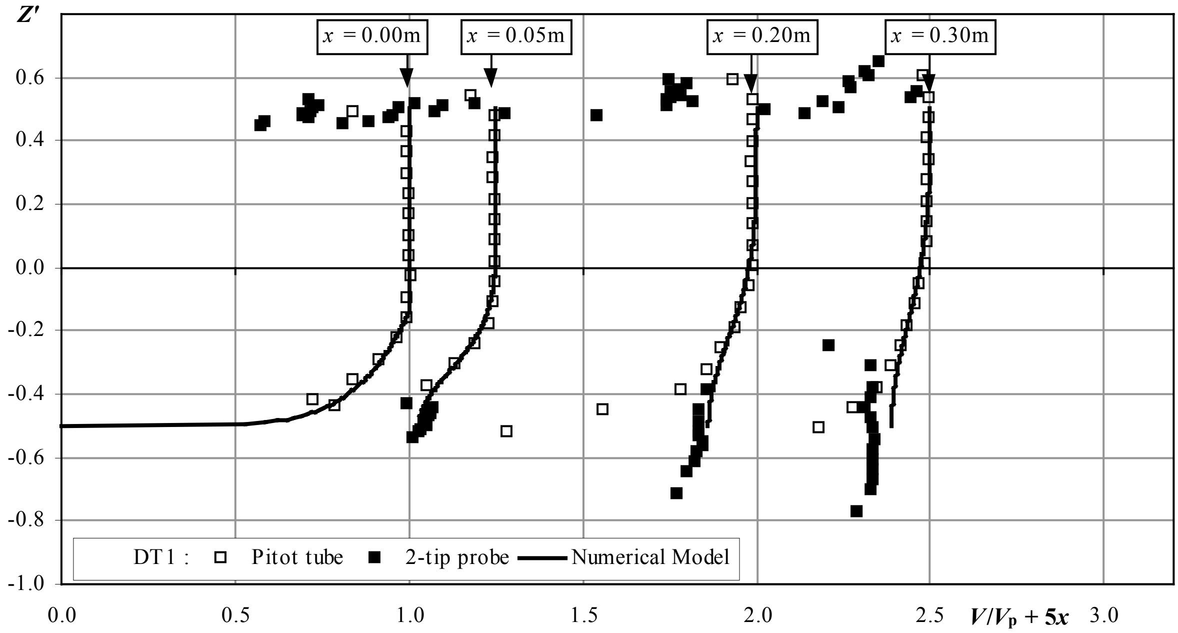
Notes: a from current study
b from CHANSON (1988)

B.5.2.3 Comparison of Results

Comparison between the Numerical Model and experimental data is shown for Experiments DT1 and DT5 in Figure B-4(a) and (b) respectively. Z' is the dimensionless altitude for the free-falling jet, centred about a point midway between the points of 50% air concentration at the upper and lower interface, $Z' = Z - (Z_{50\text{-UpperNappe}} + Z_{50\text{-LowerNappe}})/2$, V_p is the potential (uniform) flow velocity at that section, and x is the longitudinal distance in metres.

In Figure B-4, the dark symbols represent velocity data obtained with a double-tip conductivity probe, while the white symbols are data obtained using a Pitot tube. The double-tip conductivity probe requires the presence of a significant number of air-bubbles to obtain a representative measurement of the velocity, and hence the accuracy becomes questionable in regions of very high or very low air concentration, say $C < 5\%$ and $C > 95\%$. Further, it is believed that the data obtained at the upper interface is 'corrupted' by roughness of the free surface rather then air-bubbles, hence the large scatter obtained. The accuracy of the Pitot tube decreases significantly as the air concentration increases. The velocity measured by the Pitot tube is dependent upon the density of the fluid surrounding the probe, and the probe will increasingly underestimate the velocity as the air concentration increases at the upper and lower interfaces.

The results from the Numerical Model show, for the most part, good agreement with the experimental data. It must be noted that the Numerical Model is a monophase model of the water jet. Air-bubbles are entrained into the jet at the upper and lower surfaces and their effect on the velocity redistribution process is not modelled. The Numerical Model also neglects the effect of acceleration of the jet due to gravity and does not take into account the transfer of momentum to the surrounding air (small, but not zero) or three-dimensional effects in the jet itself. Nevertheless, the numerical model appears to predict the velocity profile within the free-jet with reasonable accuracy.



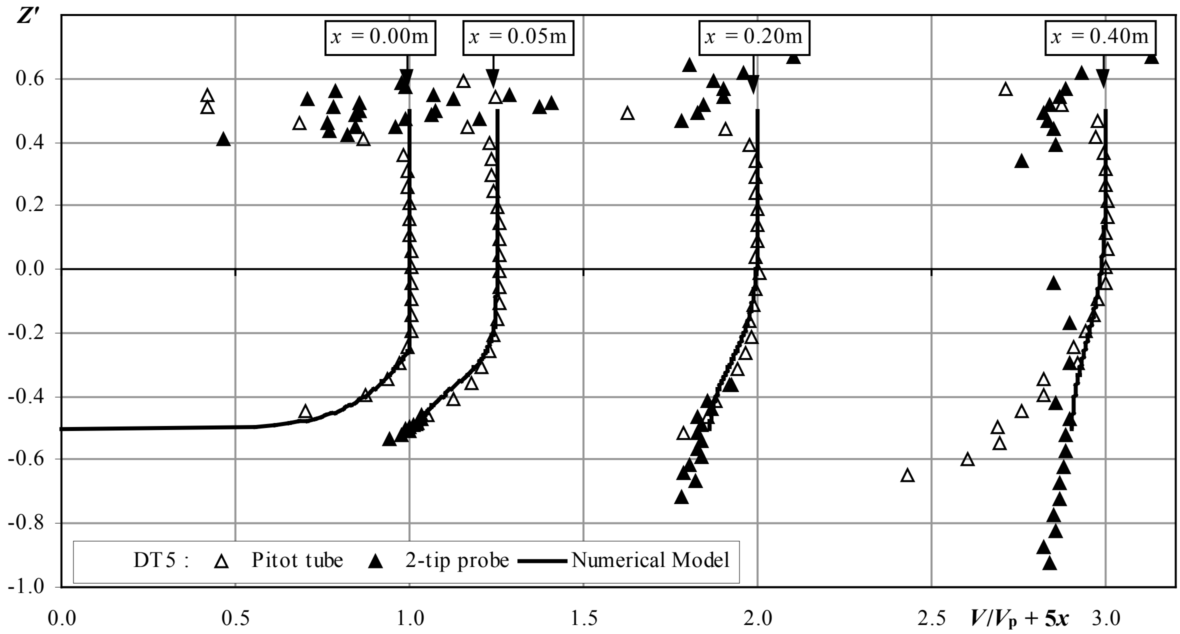


Figure B-4 Comparison of numerical model and experimental data
(a) Exp. DT1, $d_0 = 30.6$mm, $V_0 = 2.76$m/s
(b) Exp. DT5, $d_0 = 39.7$mm, $V_0 = 3.61$m/s

B.5.3 Comparison between the Numerical and Analytical Models

The ability of the analytical solutions of GOERTLER and REICHARDT to estimate the results of the numerical model, and hence experimental results, were compared for a wide range of conditions (combinations of V_0, d, δ_{99}, n and $\chi_1 c$). The constants ν_t and C from GOERTLER's solution, and $c_d d$ and β from REICHARDT's solution that correspond to these preconditions may be determined using the procedures outlined in Sections B.3.3.1 and B.3.3.2 respectively.

The results from the Numerical Model display a similar shape to the analytical solutions, in particular GOERTLER's solution. A better agreement between the results is obtained by using slightly different origin points for the numerical and analytical solutions, i.e. $\xi_n \neq \xi_a$, where the subscripts 'n' and 'a' refer to the numerical model and analytical models respectively.

The inflow conditions and analytical solution constants for a typical flow condition, as might be found on the single step model, are listed in Table B-3. The analytical solutions and results from the Numerical Model are compared using the offsets:

$$\xi_a = x_{b=d} \approx 0.060\text{m} \quad \rightarrow \quad x_a = x + 0.06\text{m}$$

$$\xi_n = \tfrac{2}{3}\, x_{b=d} \approx 0.040\text{m} \quad \rightarrow \quad x_n = x + 0.04\text{m}$$

where x is the distance from the step brink. The results are shown at several cross-sections in Figure B-5. From Equation (B-44), the analytical solutions should be applicable within the range 0.26m < x < 0.54m.

Table B-3 Variables and constants used for comparison of numerical model and analytical solutions

Uniform velocity, V_0	[m/s]	3.0
Flow depth, d	[m]	0.030
Boundary layer depth, δ_{99}	[m]	0.010
Power law factor, n		6.67
Virtual origin offset, ξ_n	[m]	0.040
Eddy viscosity constant, $\chi_1 c$	[m$^{1/2}$]	0.00150

GOERTLER's Solution:	ν_t	[m²/s]	0.00032
	C	[m$^{1/2}$]	0.0712
REICHARDT's Solution:	β		0.178
	$c_d d$	[m]	0.00522
Virtual origin offset, ξ_a		[m]	0.060

The results in Figure B-5 show a good agreement between the Numerical Model and the analytical solutions. As could be expected, the Numerical Model results are more accurately predicted by GOERTLER's solution since they share some of the same assumptions for shear stress distribution, which are slightly different to that used by REICHARDT's solution. By x = 0.20m (x_n = 0.26m or $x/c_d d \approx 50$), the maximum difference between the Numerical Model and GOERTLER's solution is less then 0.3%.

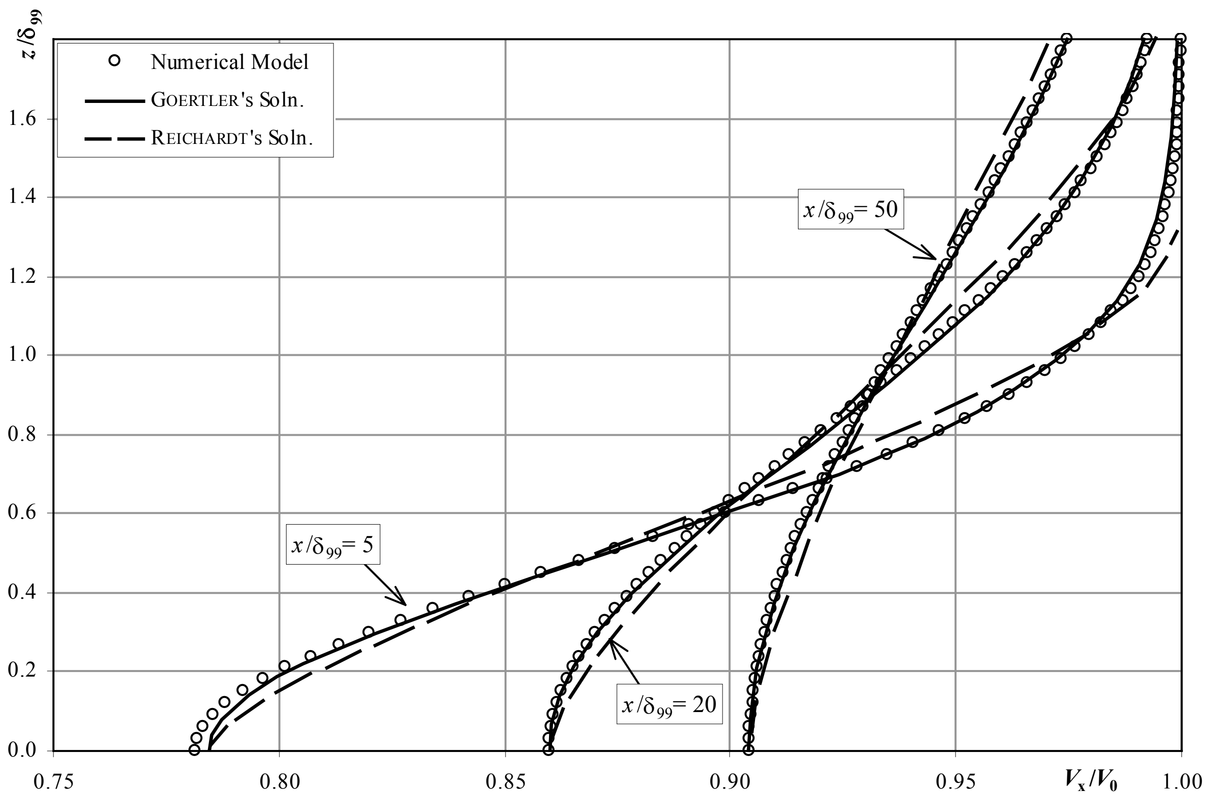


Figure B-5 Comparison of the numerical and analytical models

B.5.4 Modification for a Variable Air-Concentration Profile

The analytical solutions for wake flow and the numerical model are derived for a coherent, monophase jet discharging into a void, and do not account for the entrainment of air at the surfaces of the water jet. The air-water mixture has a lower overall density than pure water and hence occupies a greater volume, a process known as 'flow bulking'. The output from the models can be adapted to account for this process. For a given air-concentration profile, the vertical scaling can be adjusted using the continuity equation, assuming that $\rho_a << \rho_w$:

(B-50) $$\int_{z_1}^{z_2} V(z)\,dz = \int_{z'_1}^{z'_2} \left(1 - C(z')\right) V(z')\,dz'$$

where V is the velocity of the water or air-water mix, C is the air concentration, z are the vertical coordinates assuming no air entrainment, and z' are the modified coordinates. Across a small distance, this becomes:

(B-51) $$\delta z' = \frac{\delta z}{(1 - C)}$$

assuming V and C are constant across δz.

It can be seen from Equation (B-51) that the scaling of the modified coordinate system relative to the original is inversely proportional to the water fraction ($1 - C$). The effect of the air entrainment is to diffuse the velocity profile away from the clearwater region of the flow, as shown at the lower interface in Figure B-6. The rate of diffusion increases as the air concentration increases.

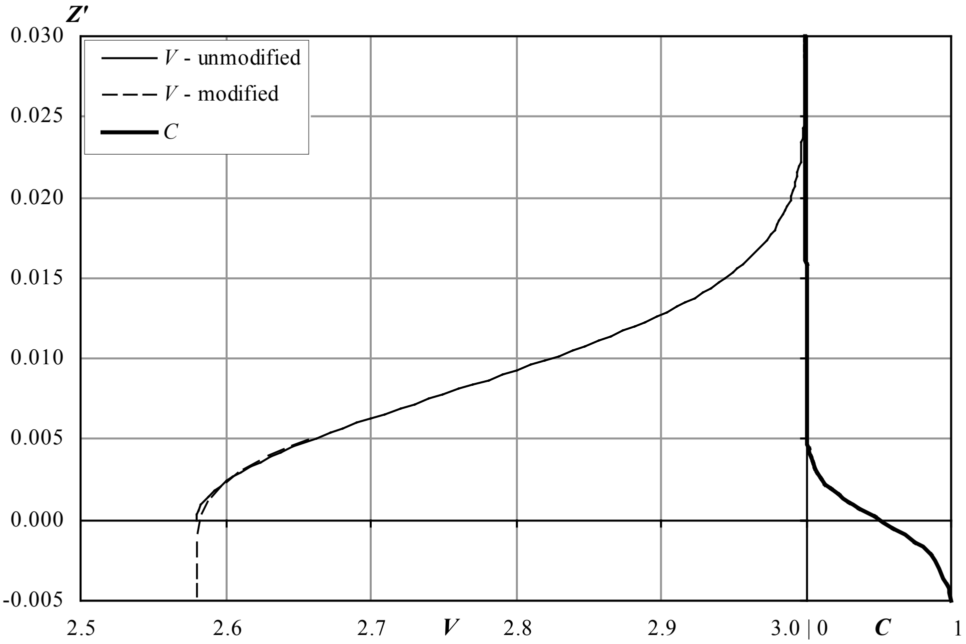


Figure B-6 Effect of air entrainment on the calculated velocity profile

Another relevant point highlighted by the results shown in Figure B-6 is that the modified velocity profile is relatively constant across the aerated interface, particularly for $C > 0.5$ to 0.6. This shows good agreement with the experimental velocity measurements in the air-water interface (e.g. conductivity probe data, Figure B-4) which show little variation in velocity across the interface.

B.6 SUMMARY

Analysis of data from the current study indicates that the loss of momentum from a water jet discharging into air is negligible. This refutes some current theories (CHANSON 1993, 1996), which model the velocity profile based on GOERTLER's solution for a free-jet boundary (i.e. a jet discharging over a stagnant pool of *the same fluid*), a solution that implies a significant loss of momentum from the jet.

A boundary layer forms on the step upstream of the drop as a result of viscous interaction between the step and the water. The velocity profile may be approximated by a power-law distribution within the boundary layer and uniform velocity outside. The viscous shear force on the lower water interface is not present downstream of the step brink, resulting in a force imbalance within the jet and leading to a redistribution of the velocity profile. The gradient of the force imbalance is a function of the derivative of the velocity gradient, while the shear stress at the upper and lower boundary of the jet is equal to zero, i.e.:

$$\tau = f\left(\frac{\partial V_x}{\partial z}\right) = 0 \text{ at boundary} \qquad \text{and} \qquad \frac{\partial \tau}{\partial z} = f\left(\frac{\partial^2 V_x}{\partial z^2}\right)$$

hence a uniform velocity profile ($\partial V_x/\partial z = 0$) will witness no change to the velocity along the jet. This is consistent with observations at the upper interface from the current study (uniform velocity outside boundary layer) and data from CHANSON and BRATTBERG (1997), which presented data from experiments on a vertical wall-jet.

The redistribution of the velocity profile within the jet may be modelled with reasonable accuracy by numerical integration of the simplified Navier-Stokes and Continuity equations (Section B.4):

(B-52) $$V_x \frac{\partial V_x}{\partial x} + V_z \frac{\partial V_x}{\partial z} = \frac{1}{\rho} \frac{\partial \tau_t}{\partial z}$$

(B-53) $$\frac{\partial V_x}{\partial x} + \frac{\partial V_z}{\partial z} = 0$$

although some approximations are necessary to estimate the shear stress, τ_t (Section B.4.1).

Additionally, the above equations may be approximated using analytical solutions for wake flow developed by REICHARDT (1951) (Section B.3.2.1):

(B-54) $$\frac{V_x}{V_0} = 1 - \frac{\sqrt{10}}{18\beta}\sqrt{\frac{c_d d}{x}}\left(1 - \left(\frac{z}{b}\right)^{3/2}\right)^2$$

and GOERTLER (1942) (Section B.3.2.2):

(B-55) $$\frac{V_x}{V_0} = 1 - \frac{C}{\sqrt{x}} \exp\left(-\frac{V_0 z^2}{4\nu_t x}\right)$$

where β, $c_d d$, C and ν_t are constant and $b = \sqrt{10}\beta(c_d d\ x)^{1/2}$.

These solutions are only valid in the 'far wake' region, where $V_0 - V_x << V_0$.

APPENDIX C – PARABOLIC BUBBLE-FREQUENCY DISTRIBUTION

The relationship between bubble frequency and time-average air concentration at a section has been observed to be approximately parabolic in a number of flow situations, including free-surface aeration of open channel flows (CHANSON 1997b) and two-dimensional free-falling jets (CHANSON and BRATTBERG 1997). A parabolic relationship is also observed within the turbulent shear region of hydraulic jumps (CHANSON and BRATTBERG 1997). These results, together with the data from the current investigation, suggest that the bubble-frequency distributions are reasonably well correlated by:

(C-1) $$\frac{F_a}{F_{max}} = 4C(1-C)$$

where C is the time-average air concentration, F_a is the bubble frequency and F_{max} is the cross-sectional maximum bubble frequency. An explanation for this relationship has not been previously explored.

C.1 DISCRETE ELEMENT HYPOTHESIS

Consider a hypothetical section of a bubbly flow passing a fixed point at constant velocity, V, for a period of time, t. The length of the sample is $L = V\,t$ (Figure C-1). If the signal is divided into N equal segments, the length of each segment, λ, is given by:

(C-2) $$N = \frac{L}{\lambda} = \frac{V\,t}{\lambda}$$

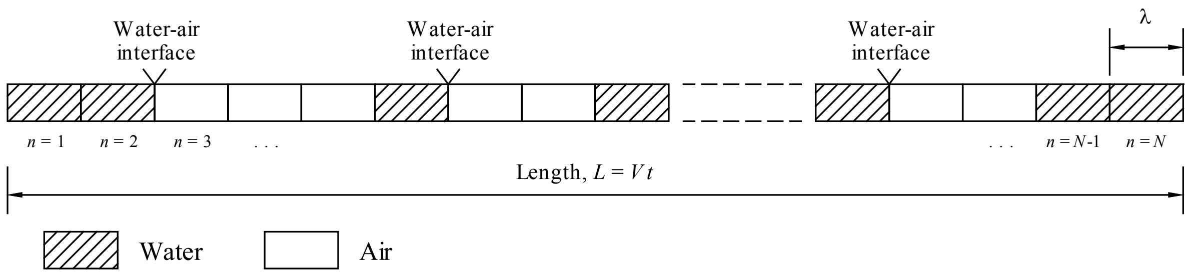


Figure C-1 Definitions for the discrete element hypothesis

If it is assumed that each segment is either entirely air or entirely water, the probability that any given segment is air or water is given by:

(C-3) $\Pr(\text{air}) = C$ and $\Pr(\text{water}) = 1 - C$

where C is the void fraction. Practically, the value of C is the probability of a probe-tip being in air during the scanning time, and is equal to the true void fraction if $V_{\text{air}} = V_{\text{water}}$.

Each air-bubble is equivalent to one transition from water to air. The bubble frequency is therefore simply the number of water-to-air interfaces per second. Taking a single arbitrary segment of the sample, the segment marks the beginning of an air-bubble if:

a) the segment is air, and
b) the previous segment was water.

Assuming that the probability for a segment to be in air or water is independent of the state of the adjacent segments, the probability of a segment being associated with one water-air interface is equal to:

(C-4) Pr(interface) = Pr(segment is air) Pr(previous segment is water) = $C(1 - C)$

The total number of water-air interfaces in the sample will on average be equal to:

$$\begin{aligned} N_{\text{int}} &= \sum_{n=1}^{N} \Pr(n \text{ is air}) \Pr(n-1 \text{ is water}) \\ &= \sum_{n=1}^{N} C(1-C) \\ &= N\, C(1-C) \end{aligned}$$

Combining this with Equation (C-2), the bubble frequency, F_a, is equal to the number of water-air interfaces per second, and is calculated as:

(C-5) $$F_a = \frac{N_{\text{int}}}{t} = \frac{V}{\lambda} C(1-C)$$

If V and λ are assumed to be constant and independent of C, the differentiation of Equation (C-5) proves that the maximum frequency occurs for $C = 0.5$, and has a value given by:

(C-6) $$F_{\max} = \frac{V}{\lambda} 0.5\,(1-0.5) = 0.25 \frac{V}{\lambda}$$

Equations (C-5) and (C-6) yield the parabolic relationship between bubble frequency and air concentration:

(C-1) $$\frac{F_a}{F_{\max}} = 4C(1-C)$$

A close examination of Equation (C-5), however, shows a problem with the basic assumptions. Equation (C-5) implies that the average frequency, F_a, is inversely proportional to λ. If λ is arbitrary and is decreased to approach zero then F_a approaches infinity. Experimental results show that there is a finite value for the peak frequency, F_{max} (between 10Hz and 500Hz for the current study). There is clearly a physical meaning for the length λ.

The problem lies in an assumption used in Equation (C-4), which implies that the nature of a segment (air or water) is independent of the nature of the surrounding segments. Experimental observations show that the multiphase flow consists of bubbles or droplets with a typical or modal size. If the length λ is much smaller than the typical bubble/droplet size, and if a single segment is air, then the probability for the adjacent segments to also be air is much higher: that is, if Pr(n is air) = C, then Pr($n - 1$ is air) >> C.

If the air-water mixture is pictured as a 'mist' of independent air and water particles, the probability of a single particle being air or water IS INDEPENDENT of the surrounding particles. λ therefore may be considered as a scaling factor, and is a function of the 'grouping' of the air and water particles. In a highly fragmented flow, the 'grouping' of air and water particles will be small and the bubble frequency will be high.

Proposal:

λ is a length scale such that the probability of a discrete element of that size being air or water is independent of the surrounding segments.

The value of λ may be determined as:

(C-7) $$\lambda = \frac{V}{4 F_{max}}$$

The bubble frequency is related to the geometric mean air-bubble chord-length, $(ch_a)_{mean}$, and water-droplet chord-length, $(ch_w)_{mean}$, as:

(C-8) $$(ch_a)_{mean} = \frac{V\,C}{F_a} \quad \text{and} \quad (ch_w)_{mean} = \frac{V(1-C)}{F_a}$$

Combining Equations (C-5) and (C-8) gives:

(C-9) $$\lambda = (ch_a)_{mean}(1-C) \quad = (ch_w)_{mean}\, C$$

In regions of low air concentration ($C \rightarrow 0$) the length scale, λ, becomes equal to the average chord-length of a single air-bubble. Similarly, the length scale, λ, becomes equal to the average chord-length of a single water-droplet in regions of high air concentration ($C \rightarrow 1$).

A simple way to visualise this model is to consider the air-water mixture as a series of discrete air and water elements or 'building blocks'. These elements are joined together in random fashion. If two (or more) air elements are united, they merge to form a single air-bubble, while the same applies for water elements. The mean air concentration is the proportion of the total number of elements that are air elements.

C.2 MODIFICATIONS TO THE DISCRETE ELEMENT HYPOTHESIS

The discrete element hypothesis is based on a number of assumptions, most of which regard the selection of the length scale, λ. The length scale, λ, has a vague physical meaning. It is equal to the average chord-length of a discrete air-bubble or water-droplet in regions of high or low air concentration respectively. In between, however, its meaning becomes less clear. The length scale is assumed to be:

- identical for both air and water elements,
- independent of the mean air concentration, C, and
- independent of the air-bubble and water-droplet chord-length distributions.

By assuming that λ is constant and independent of C, it is implied that a large air-bubble is simply the compilation of several small air-bubbles. This assumption has a complete disregard for the shape or size of the bubbles, how they fit together, the effect of surface tension and shear forces in the fluid etc. An examination of experimental data obtained from the present study suggests that, although the parabolic relationship provides a reasonable approximation, there are several discrepancies. For example, the experimental bubble frequency for $C < 0.5$ within the lower nappe interface is significantly higher than that predicted by the parabolic relationship (see Figure C-4, Page C-11). Some of the assumptions employed in the discrete element hypothesis would therefore appear to be unrealistic.

C.2.1 Bubble/Droplet Distributions.

The discrete element hypothesis assumes that the air and water elements are all of a uniform size. Investigation of the probability distributions of the air-bubble and water-droplet chord-lengths shows that the observed chord-lengths are not of uniform size, but rather the size distribution may match a gamma, Weibull, or log-normal probability distribution.

A computer model was developed and used to test the discrete element hypothesis and subsequent theoretical developments. Simulated ‘lengths’ of bubbly flow are generated by compiling a string of air and water elements. The numbers of air and water segments are proportioned according to the mean air concentration and are assembled in *random order*. The frequency of air and water structures can be obtained by counting the number of interfaces between sequential water and air elements. The results, using a constant element size, show excellent agreement with the parabolic relationship given by Equation (C-5).

When tested with different probability distributions for the size of the air and water elements, the model results show that:

- the parabolic relationship is independent of the probability distribution of the element size (e.g. uniform, normal, log-normal etc.). This includes cases for which the water element and air element sizes have different distributions and the mean size of the air and water elements are different (see Section C.2.2); and
- the bubble-frequency distribution is a function of the AVERAGE size of the element, not of the probability distribution of the size.

C.2.2 Typical Bubble/Droplet Sizes

Previous studies have suggested that the size of a bubble is a function of the surface tension forces of the bubble (which act to hold the bubble together) and the shear forces in the surrounding fluid (which act to tear it apart). HINZE (1955) proposed that the splitting of air-bubbles in water occurs for:

(C-10) $$\phi_a > \frac{2\sigma We_c}{\rho_w v'^2}$$

where σ is the surface tension between air and water, ϕ_a is the bubble diameter, v'^2 is the spatial average value of the square of the velocity differences over a distance equal to ϕ_a, ρ_w is the density of the surrounding fluid and We_c is the critical Weber number for bubble splitting (see Appendix A.3.1).

Equation (C-9) implies that $\lambda \to (ch_a)_{mean}$ as $C \to 0$ and $\lambda \to (ch_w)_{mean}$ as $C \to 1$. If λ is constant, $(ch_a)_{mean}$ will be equal to $(ch_w)_{mean}$ at conjugate values of C and $(1 - C)$. An investigation of the average chord-lengths of the air-bubbles and water-droplets suggests that this statement is true for the current study in the upper nappe interface, where the velocity is approximately uniform. In the lower nappe however, where a velocity gradient occurs ($v'^2 > 0$), the average water-droplet chord-length is around 25% larger than the air-bubble chord-length at comparative air concentrations.

It is likely that the turbulent shear forces acting on an air-bubble in water are greater than the shear forces acting on a water-droplet in air. As a result, the average size of an air-droplet in water will tend to be less then an air-droplet in water at a similar location. HINZE's relationship predicts the same trend: $(\phi_a)_{max} \propto 1/\rho_w$.

Consider a section of the flow similar to that used in Section C.1 (Figure C-1), except this time the air and water elements have different length scales; λ_a and λ_w respectively. The length of the sample, L is given by

(C-11) $$L = N_a \lambda_a + N_w \lambda_w = V\,t$$

where V is the velocity, t the time of the sample, and N_a and N_w are the number of air and water elements in the sample respectively. The mean air concentration C is:

(C-12) $$C = \frac{N_a \lambda_a}{N_a \lambda_a + N_w \lambda_w}$$

Combining equations (C-11) and (C-12) returns:

(C-13) $$N_a = V\,t\,\frac{C}{\lambda_a} \quad \text{and} \quad N_w = V\,t\,\frac{(1-C)}{\lambda_w}$$

The probability that a given segment is air or water is:

(C-14) $$\Pr(\text{air}) = \frac{N_a}{N_a + N_w} \quad \text{and} \quad \Pr(\text{water}) = \frac{N_w}{N_a + N_W} = 1 - \Pr(\text{air})$$

The average total number of water-air interfaces in the sample will be equal to:

$$\begin{aligned} N_{\text{int}} &= \sum_{n=1}^{N} \Pr(n \text{ is air}) \Pr(n-1 \text{ is water}) \\ &= \sum_{n=1}^{N} \frac{N_{\text{a}}}{N_{\text{a}} + N_{\text{w}}} \frac{N_{\text{w}}}{N_{\text{a}} + N_{\text{w}}} \\ &= \frac{N_{\text{a}} N_{\text{w}}}{N_{\text{a}} + N_{\text{w}}} \qquad \left(N = N_{\text{a}} + N_{\text{w}}\right) \end{aligned}$$

Substituting Equation (C-14) returns:

(C-15) $$N_{\text{int}} = \frac{(V\,t)^2 \dfrac{C}{\lambda_{\text{a}}} \dfrac{(1-C)}{\lambda_{\text{w}}}}{V\,t\left(\dfrac{C}{\lambda_{\text{a}}} + \dfrac{(1-C)}{\lambda_{\text{w}}}\right)} = V\,t \frac{C(1-C)}{\lambda_w C - \lambda_{\text{a}}(1-C)}$$

Equation (C-15) may be written as:

(C-16) $$F_{\text{a}} = \frac{V}{\alpha(C)\lambda_{\text{a}}} C(1-C)$$

where $\alpha(C)$ is a correction factor, defined as:

(C-17) $$\alpha(C) = 1 + \left(\frac{\lambda_{\text{w}}}{\lambda_{\text{a}}} - 1\right) C$$

The effect of $\alpha(C)$ on the parabolic relationship is to skew the curve in the direction of the smaller element length, so if $\lambda_{\text{a}} < \lambda_{\text{w}}$ then the peak frequency will occur for $C < 0.5$.

C.2.3 Variation of λ with Mean Air Concentration

Substituting Equation (C-8) into (C-16) gives:

(C-18) $$\alpha(C)\lambda_{\text{a}} = (ch_a)_{\text{mean}}(1-C) \quad = (ch_{\text{w}})_{\text{mean}}\, C$$

Equation (C-18) implies that λ_{a} is equal to the average chord-length of a single bubble in a region of the flow with low air concentration (i.e. $C \to 0$), while λ_{w} is equal to the average chord-length of a water-droplet in regions of high air concentration ($C \to 1$). These values may be deduced from experimental data. However, if these values are assumed to be constant across the cross-section then it is found for data from the current study that Equation (C-16) predicts the bubble frequency with reasonable accuracy in regions of high or low air concentration, but significantly overestimates the bubble frequency in between.

The assumption that λ_a and λ_w are constant and independent of C is unlikely to be correct. Air-bubbles and water-droplets are entrained into and ejected from the flow at the free surface. They exist as independent bubble and droplet entities in regions of low and high air concentration. It is conceivable that, between these extremes, bubbles collide and merge to form a single large bubble, or a single bubble may be torn apart by shear stresses to form several smaller bubbles. The original assumption of a constant λ_a would imply that a large chord-length measured by the probe is the compilation of several small chord-lengths placed end-for-end. Such a statement neglects the effect of the shape or size of the bubbles, how they fit together, the effect of surface tension and shear forces in the fluid etc.

Examination of current experimental data suggests that the values of λ_a and λ_w are a function of the time-average air concentration only. The length scale, λ_a, may be transformed as:

(C-19) $$\lambda_a = \beta(C)\lambda$$

where β is a correction factor (function of C) such that λ is a length scale that is constant and independent of C. Equation (C-16) becomes:

(C-20) $$F_a = \frac{V}{\alpha(C)\beta(C)\lambda} C(1-C)$$

Assuming that the ratio λ_w/λ_a is constant across the section, Equation (C-16) can be used to calculate values of $\lambda_a = \beta(C)\lambda$ for the experimental data. Values of β/β_{max} ($= \lambda_a/(\lambda_a)_{max}$) measured in the lower nappe interface for experiments DT1 to DT5 of the current project are shown in Figure C-2, where β_{max} is the typical maximum[a] observed value of $\beta(C)$. The results suggest that $\beta(C)$ is maximum at $C \approx 0.5$. Since the scaling of β and λ is arbitrary, if λ is scaled such that $\beta_{max} = 1$ (and hence $\lambda = (\lambda_a)_{max}$), then the correction factor $\beta(C)$ may be correlated by:

(C-21) $$\beta(C) = 1 - b(1-2C)^4$$

where b is a constant, characteristic of the maximum variation of β (i.e. $1 - b \leq \beta \leq 1$). A value of $b \approx 0.4$ is typical for the current study in most investigated circumstances (lower and upper nappe interface air-water shear layers, free surface aeration at the end of the step etc.).

[a] The value of β_{max} is chosen to provide a good representation of the scatter of data, and is not necessarily the absolute maximum value observed.

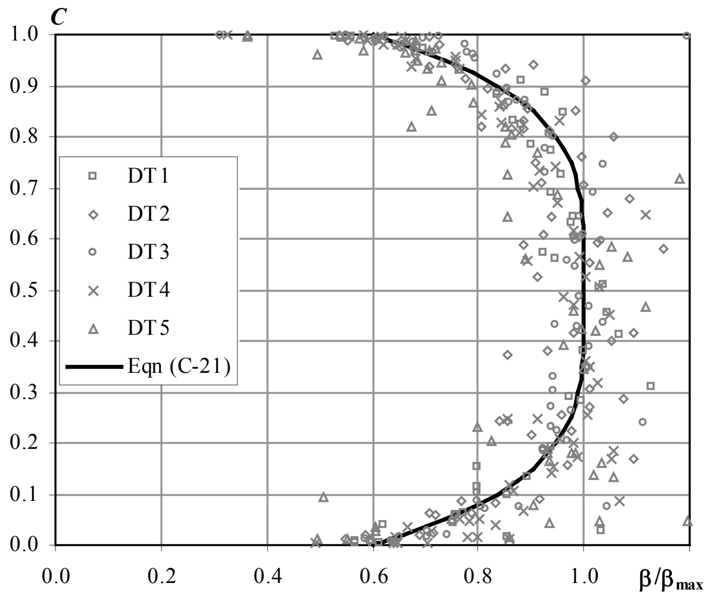


Figure C-2 Experimental values for the correction factor β

C.3 SUMMARY

Data from a number of studies showed that the bubble frequency and mean air concentration follow an approximately parabolic relationship. A simplified analogy is to picture the air-water mixture as a series of discrete air and water elements (Figure C-3). Where two (or more) elements of the same type touch, they merge to form a single air-bubble or water-droplet. The elements may have any size probability distribution, but the average size of the air and water elements are given by λ_a and λ_w respectively. The length scaling of λ_a and λ_w is such that the probability of a discrete element of that size being air or water is independent of the surrounding segments. The average length of an air segment, λ_a, is equal to the average chord-length of a single air-bubble in a region of low air concentration ($C \to 0$). Similarly, the length λ_w is equal to the average chord-length of a single water-droplet in a region of high air concentration ($C \to 1$).

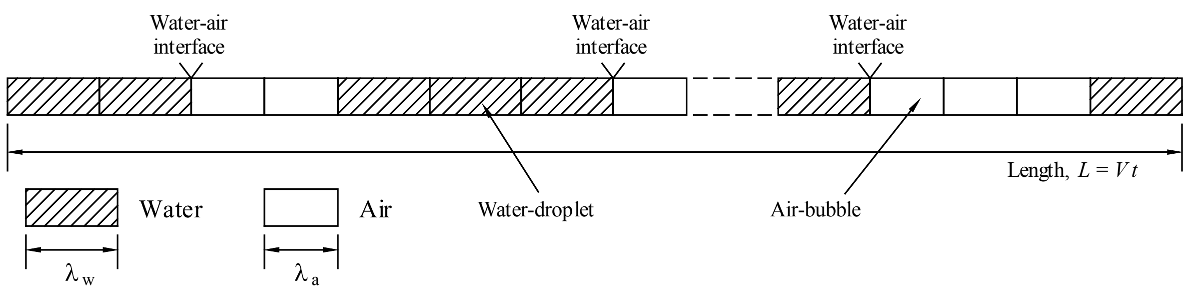


Figure C-3 Simplified model of an air-water mixture

The parabolic relationship (Equation (C-1)) is obtained by assuming that $\lambda_a = \lambda_w$ and is constant over the cross-section. The accuracy of the correlation can be further improved by applying two correction factors, $\alpha(C)$ and $\beta(C)$, to the basic equation:

(C-22) $$F_a = \frac{V}{\alpha(C)\beta(C)\lambda} C(1-C)$$

where V is the velocity of the air-water mix, C is the time-average air concentration, λ is a constant length scale factor, $\alpha(C)$ is a correction accounting for $\lambda_a \neq \lambda_w$, and $\beta(C)$ is a correction for variation of λ_a with C such that $\beta(C)\,\lambda = \lambda_a$ at any cross section.

The correction factor $\alpha(C)$ accounts for the average size of the air elements, λ_a, having a different value to the average size of the water elements, λ_w, at any given point:

(C-23) $$\alpha(C) = 1 + \left(\frac{\lambda_w}{\lambda_a} - 1\right) C$$

The ratio λ_w/λ_a is assumed to be constant across the section (i.e. independent of C). For the current study, $\lambda_w/\lambda_a \approx 1.0$ in the upper nappe interface and $\lambda_w/\lambda_a \approx 1.25$ in the lower nappe.

$\beta(C)$ is a correction factor to account for variation of λ_a and λ_w with air concentration, C:

(C-24) $$\beta(C) = 1 - b(1-2C)^4$$

where b is a constant characteristic of the maximum variation of β (i.e. $1 - b \leq \beta \leq 1$). For the current study, $b \approx 0.4$ in most observed situations.

C_{Fmax}, the value of the air concentration corresponding to the maximum bubble frequency, F_{max}, is a function of λ_w/λ_a, and b. Assuming that $\beta(C_{Fmax})$ is relatively constant and approximately equal to unity (say $0.3 < C_{Fmax} < 0.7$, see Figure C-2), C_{Fmax} and F_{max} become a function of λ_w/λ_a only, and may be calculated with good accuracy[b] as:

(C-25) $$C_{Fmax} \approx \left(\sqrt{\frac{C(1-C)}{\alpha(C)}}\right)_{Fmax} \approx \begin{cases} \dfrac{\sqrt{\lambda_w \lambda_a} - \lambda_a}{\lambda_w - \lambda_a} & \lambda_w \neq \lambda_a \\ 0.5 & \lambda_w = \lambda_a \end{cases}$$

[b] Assuming $b = 0.4$ and $½ \leq \lambda_w/\lambda_a \leq 2$, the maximum error for Equation (C-25) < 0.5% and for Equations (C-26) and (C-27) < 0.05%

The maximum air-bubble frequency is approximately equal to:

(C-26) $$F_{\text{max}} \approx \frac{V}{\lambda} C_{\text{Fmax}}^2$$

Finally, the modified parabolic relationship between F_a and C may be written as:

(C-27) $$\frac{F_a}{F_{\text{max}}} = \frac{1}{\alpha(C)\beta(C)} \frac{C(1-C)}{C_{\text{Fmax}}^2}$$

A comparison of the original parabolic relationship (Equation (C-1)), the modified parabolic relationship (Equation (C-27)) and the experimental data obtained in the lower interface of the free-falling nappe from the current study is shown in Figure C-4. Similar results are observed elsewhere on the step. *It should be noted that the modified parabolic relationship is not intended to be a meticulous breakdown of a complex air-water structure, but is rather an attempt to model the relationship between bubble frequency and air concentration based on simple theory and observed behaviour.*

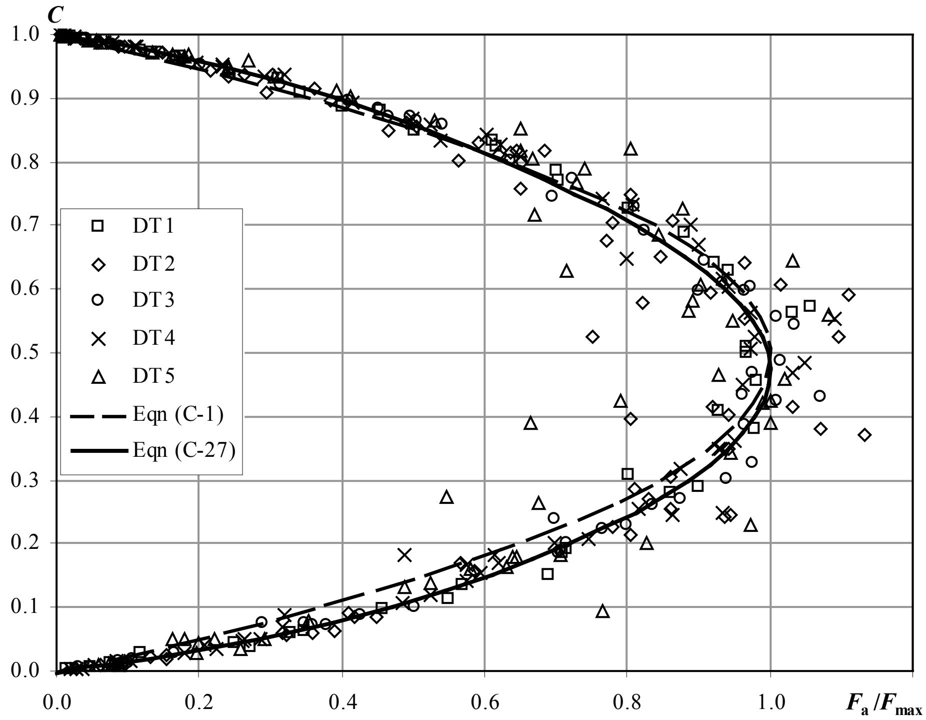


Figure C-4 Comparison of the modified parabolic relationship with experimental data
Lower nappe interface: $\lambda_w/\lambda_a = 1.25$ and $b = 0.4 \rightarrow C_{\text{Fmax}} = 0.472$

APPENDIX D – SURFACE WAVES AND BUBBLE PROPERTIES

D.1 INTRODUCTION

The investigation of air-water characteristics on a stepped cascade generally involves an investigation of the properties over a complete range of air concentrations, i.e. a transition from pure water (C = 0%) to pure air (C = 100%). At low air concentrations (i.e. C < 30%), air-bubbles typically exist as discrete bubbles, or pockets of air, completely surrounded by water. Conversely, at high air concentrations the mixture is mainly discrete water-droplets surrounded by air. Photographic evidence shows that large water-droplets containing smaller air-bubbles may be ejected upwards from the flow. For intermediate air concentrations (i.e. $0.3 < C < 0.7$), the air-water structure is complex, and its nature has not been clearly defined.

During the current investigations, a number of disparities are observed between the apparent behaviour of air-bubbles and water-droplets over the range of air concentrations. Two such discrepancies are:

- The relationship between bubble frequency and air concentration has a quasi-parabolic shape, with the frequency reaching a maximum at $C \approx 50\%$, and decreasing to zero as C tends to 0% and 100%. However, the relationship is often asymmetrical (i.e. the maximum bubble frequency does not coincide with C = 50% and $F_a(C) \neq F_a(1 - C)$, see Figure D-2); and

- The properties of the air-bubble chord-length distribution (e.g. average size, chord-length probability function) with respect to time-average air concentration, C, are different to the properties of the water-droplet chord-length distribution with respect to time-average water concentration $(1 - C)$.

These observations suggest that the behaviour of an air-bubble in water is different to a water-droplet in air. Other factors may also influence the observed results. The discrepancies highlighted above are discussed briefly in Sections D.1.2 and D.1.3 respectively, while the limitations of the measurement technique are first reviewed (Section D.1.1).

D.1.1 Limitations of the Conductivity Probe Data

An intrusive point probe, such as a conductivity or optical probe, detects the passage of air-water interfaces past a fixed point (the probe). The probe returns a one-dimensional (length only) history of the flow passing the probe tip. It cannot determine if the probe tip passed through the exact diameter of a bubble, nor give any indication of the shape of the bubble. It also cannot differentiate between a true 'air-bubble' (a pocket of air completely bounded by water) and a structure that is not entirely enclosed e.g. a surface wave. This is demonstrated in Figure D-1, which displays several air-water structures, all of which return identical signals from a fixed-point probe.

In general, any one-dimensional air structure bounded on each side is referred to as an 'air-bubble', with a measured chord-length of ch_a. Similarly, a one-dimensional water structure is referred to as a 'water-droplet', with chord-length ch_w.

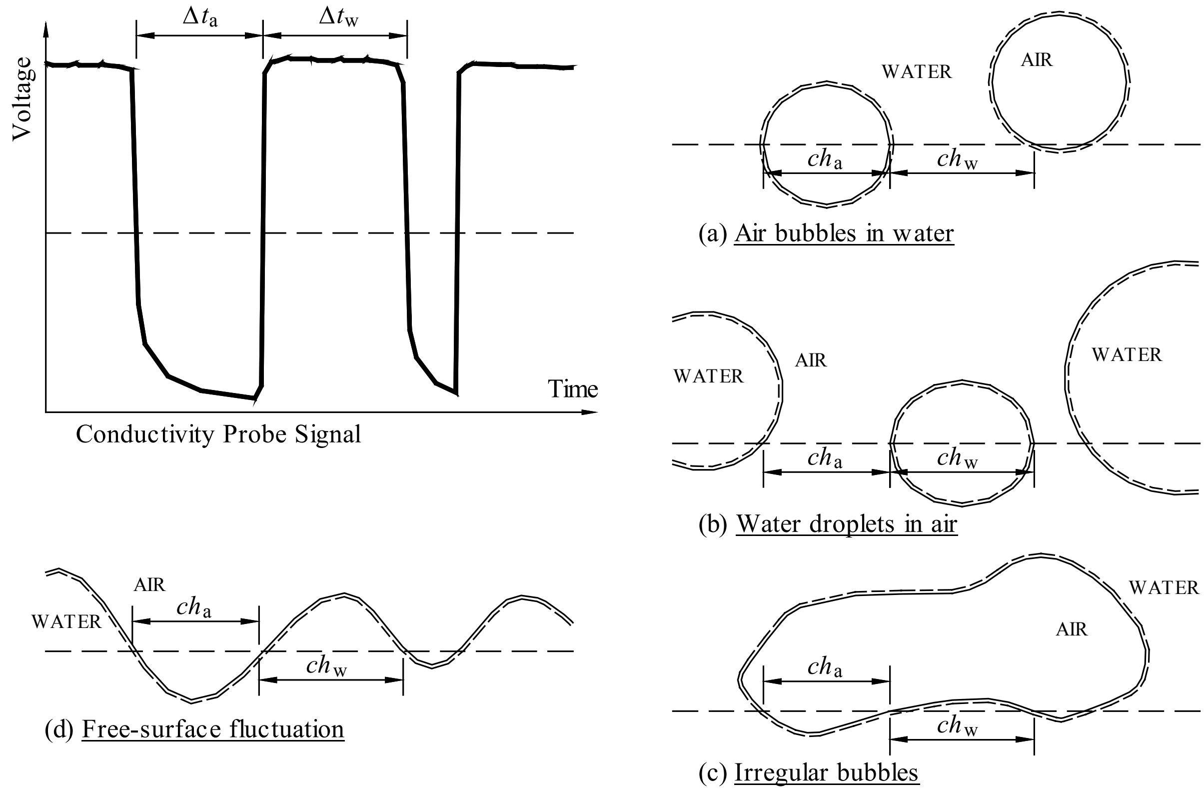


Figure D-1 Different air-water structures that result in identical probe signals

D.1.2 Bubble-Frequency Distribution

The bubble-frequency distribution at a cross-section is approximately a parabolic function of the time-average air concentration. This relationship has been observed in a number of flow situations, including free-surface aeration of open channel flows (CHANSON 1997b), two-dimensional free-falling jets (BRATTBERG ET AL. 1998), and within the turbulent shear region of hydraulic jumps (CHANSON and BRATTBERG 2000).

The parabolic relationship was originally used simply because it 'fit the data', with no theoretical justification (Discussion with H. CHANSON confirmed this fact). A simplified analogy, that the air-water mixture consists of a series of discrete air and water 'elements' of average length λ, is developed in Appendix C in an attempt to explain this relationship. No attempt is made in the analogy to explain the physical operations of the flow, and the flow structure is simply pieced together from discrete building blocks. If two (or more) elements of the same type occur consecutively, they merge to form a single air-bubble or water-droplet. The bubble frequency can be directly related to the probability of elements of the same type occurring consecutively. The resulting bubble frequency is a function of the mean element length, λ, and the time-average air concentration (a function of the relative percentage of air and water elements). If λ is assumed constant and independent of C, the resulting relationship between F and C is a parabola.

The experimental data from the current study is often skewed away from the parabolic curve. An example from experiment DT3 at x = 1.8m on the centreline is shown in Figure D-2. If the air-bubbles behave identically to water-droplets then the curve should theoretically be symmetrical about C = 0.5. This is NOT the case. A good match of the experimental data is obtained by introducing two modification functions to the standard parabolic relationship. The modified parabolic function is given as:

(D-1) $$\frac{F_a}{F_{max}} = \frac{1}{\alpha(C)\beta(C)} \frac{C(1-C)}{C_{Fmax}^2}$$

where C is the time-average air concentration, F_{max} is the maximum bubble frequency at the cross-section and C_{Fmax} is the air concentration corresponding to F_{max} (see Appendix C for details).

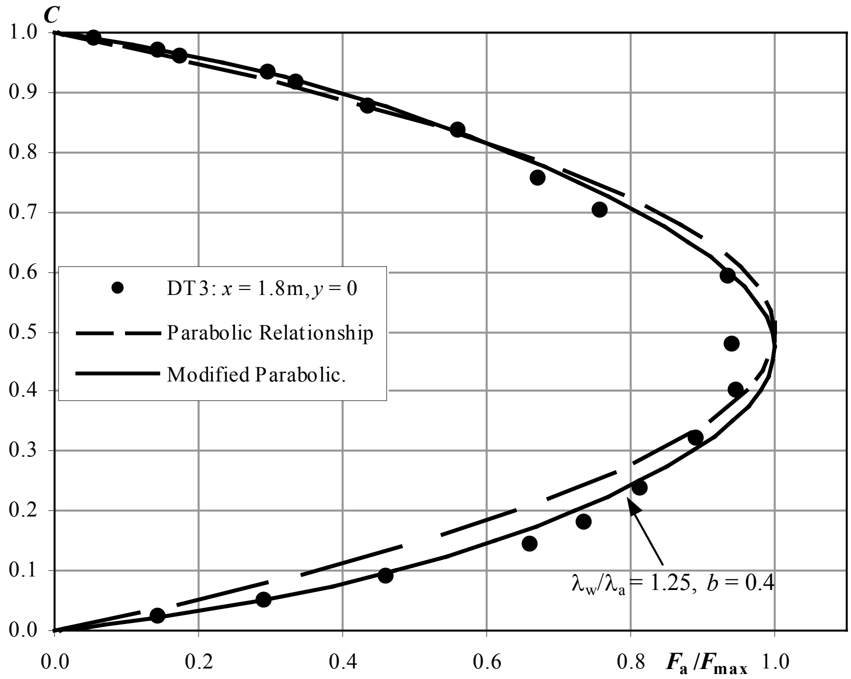


Figure D-2 Sample bubble-frequency distribution

The correction factor $\alpha(C)$ can be derived from the discrete element analogy by allowing the air and water elements to have a different average length, λ_a and λ_w respectively. **It must be noted that the analogy offers no explanation as to why $\lambda_a \neq \lambda_w$.** The effect of $\alpha(C)$ on the F_a vs. C relationship is to skew the peak in the direction of smaller element (i.e. if $\lambda_w > \lambda_a$, $C_{Fmax} < 0.5$). $\alpha(C)$ is given as:

(D-2) $$\alpha(C) = 1 + \left(\frac{\lambda_w}{\lambda_a} - 1\right) C$$

The correction factor $\beta(C)$ is an empirical relationship which can be related to the variation of λ_w and λ_a with void fraction. Based on experimental data, $\beta(C)$ may be represented by:

(D-3) $$\beta(C) = 1 - b(1 - 2C)^4$$

where b is a constant. The air concentration corresponding to the maximum bubble frequency, C_{Fmax}, is a complex function of b, λ_w and λ_a, but can be approximated with good accuracy as:

(D-4) $$C_{Fmax} \approx \left(\sqrt{\frac{C(1-C)}{\alpha(C)}}\right)_{Fmax} \approx \begin{cases} \dfrac{\sqrt{\lambda_w \lambda_a} - \lambda_a}{\lambda_w - \lambda_a} & \lambda_w \neq \lambda_a \\ 0.5 & \lambda_w = \lambda_a \end{cases}$$

While not strictly based on a physical air-water structure, the discrete element analogy nevertheless results in a good approximation of the relationship between air concentration and bubble frequency (Figure D-2). It must be noted that the analogy does not fully explain how the air and water elements relate to air-bubbles and water-droplets in a real flow. It also offers no explanation as to why the mean sizes of the air and water elements are not necessarily equal. See Appendix C for more details on the discrete element model.

D.1.3 Chord-Length Distribution

The conductivity probe can measure the chord-lengths of air-structures and water-droplets passing the probe tip. The variation in size of these chord-lengths can be output as a Probability Density Function (p.d.f.) (the probability of a chord-length being equal to a particular length), or Cumulative Distribution Function (c.d.f.) (the probability that a chord-length is of less than a particular length). Two common non-negative probability functions (i.e. chord-length ≥ 0) are the log-normal distribution and Weibull Distribution, defined as:

(D-5)
$$\text{log-normal}\left|\begin{array}{lll}\text{pdf}: & f(\chi;M',S')=\dfrac{1}{\sqrt{2\pi}S'\chi}\exp\left(-\dfrac{(\ln(\chi)-M')^2}{2S'^2}\right) & \chi>0\\ \text{cdf}: & F(\chi_u;M',S')=\displaystyle\int_0^{\chi_u}\dfrac{1}{\sqrt{2\pi}S'\chi}\exp\left(-\dfrac{(\ln(\chi)-M')^2}{2S'^2}\right)d\chi & \chi_u>0\end{array}\right.$$

(D-6)
$$\text{Weibull}\left|\begin{array}{lll}\text{pdf}: & f(\chi;\alpha,\beta)=\dfrac{\alpha}{\beta}\chi^{\alpha-1}\exp\left(-\left(\dfrac{\chi}{\beta}\right)^{\alpha}\right) & \chi\geq 0\\ \text{cdf}: & F(\chi_u;\alpha,\beta)=1-\exp\left(-\left(\dfrac{\chi_u}{\beta}\right)^{\alpha}\right) & \chi_u\geq 0\end{array}\right.$$

where χ is the air-bubble or water-droplet chord-length ch_a or ch_w, χ_u is the upper limit of χ (i.e. $\Pr(\chi < \chi_u)$), M' and S' are the mean and standard deviation of $\ln(\chi)$ respectively, α is a positive, non-zero factor and β is a scale parameter. Examples of the log-normal and Weibull distributions with a mean $M = 1$ and standard deviation $S = 0.5$ are shown in Figure D-3.

Bubble and droplet chord-length distribution functions are shown in Figure D-4 for two different air concentrations at the same vertical section through the flow well downstream of a drop (Exp. DT3, $x = 1.8$m, $y = 0$ (centreline)). Since the bubble chord-lengths are recorded as discrete values, the p.d.f. is presented as $f(\chi) = \Pr(a < \chi < b)$.

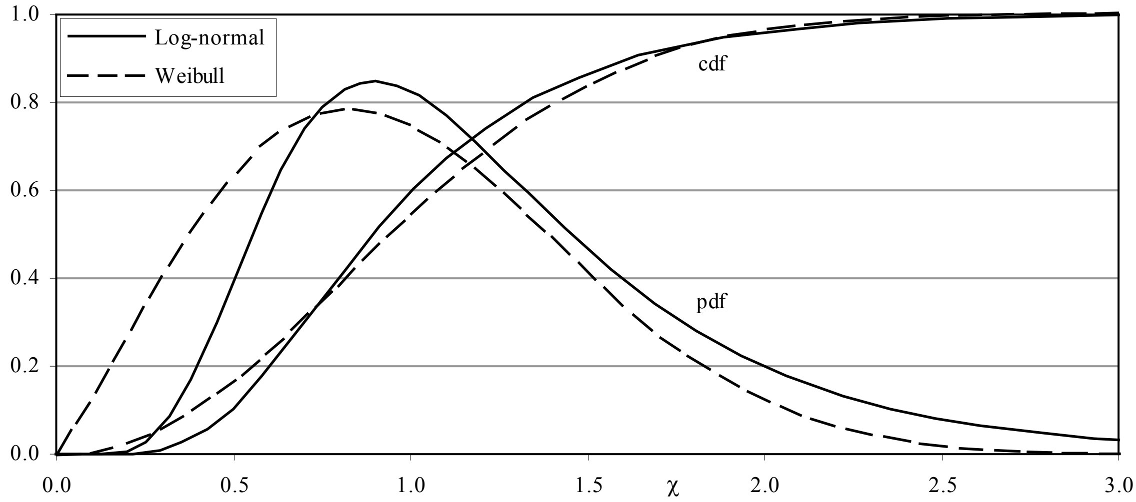


Figure D-3 Log-normal and Weibull probability functions: $M = 1$, $s = 0.5$

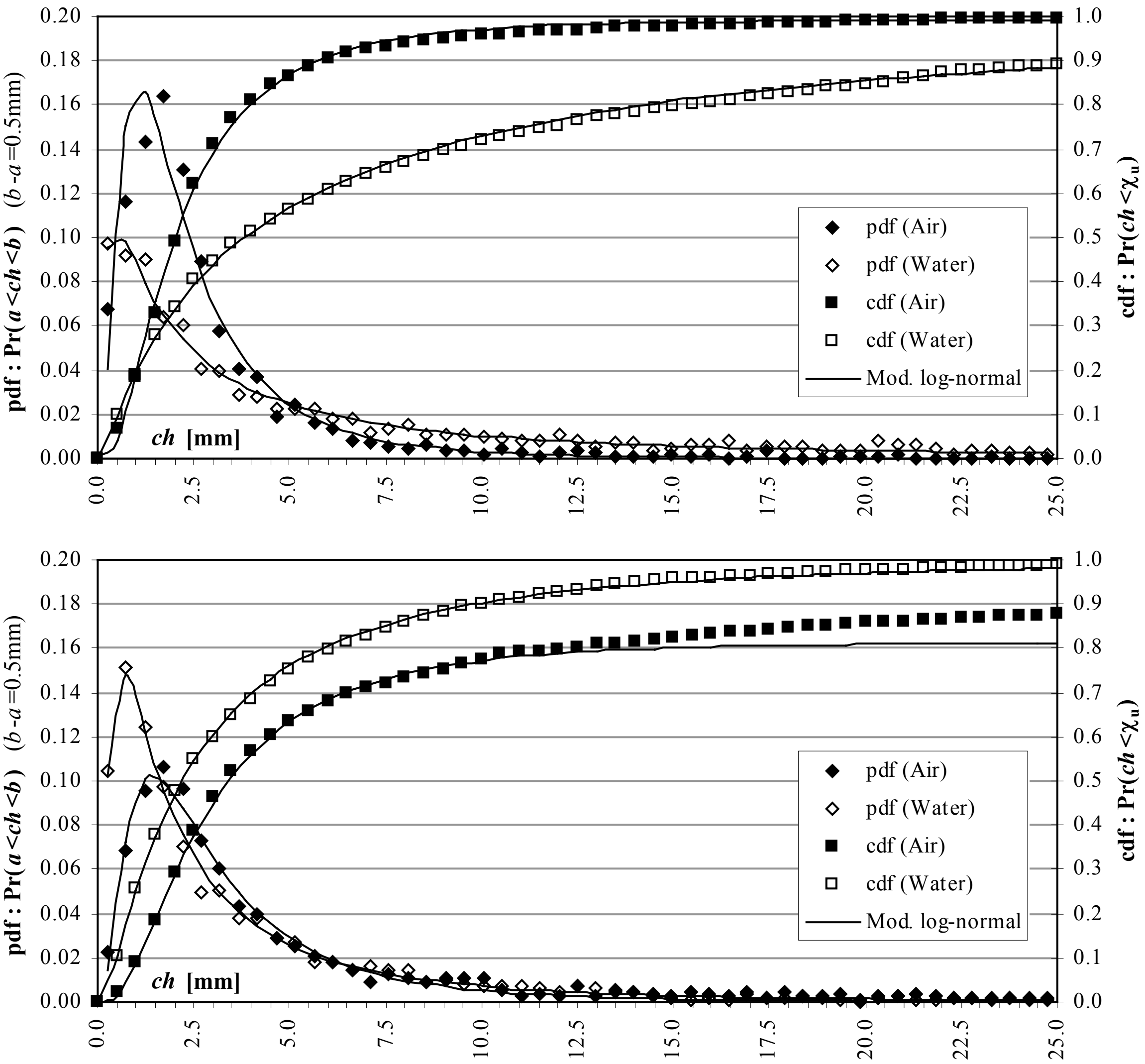


Figure D-4 Typical air-bubble and water-droplet chord-length probability distribution functions
Exp. DT3, $x = 1.8$m, $y = 0$ (centreline)
(a) $C = 0.24$, $F_a = 249$Hz, $(ch_a)_{mean} = 3.1$mm, $(ch_w)_{mean} = 9.8$mm
(b) $C = 0.76$, $F_a = 205$Hz, $(ch_a)_{mean} = 12.5$mm, $(ch_w)_{mean} = 4.0$mm

Typically, when the mean chord-length is small (low air concentration for air-bubbles, high air concentration for water-droplets), the chord-length distribution may be well represented by a standard probability distribution. At the downstream end of the step (Section 6.4.2.4), this distribution is found to fit a log-normal probability distribution. The air-bubble chord-length distribution in Figure D-4(a) ($C = 0.25$) and the water-droplet distribution in Figure D-4(b) ($C = 0.75$) are relatively similar, and both are consistent with a log-normal distribution.

Similar observations can be made in the lower interface of the free-falling nappe (an air water shear layer) and in the upper interface of the free-falling nappe (Section 5.4.5.2 and Section 5.4.5.3 respectively), although the size distributions of air-bubbles and water-droplets are better represented by a gamma or Weibull distribution than a log-normal.

In some situations, however, the shape of the chord-length distribution function changes as the mean chord-length increases. It is found that the probability distribution of the smaller chord-lengths may be still be represented by the same 'standard' distribution, but the sample tends to contain a disproportionate number of large bubble sizes (of an order of magnitude larger than the modal bubble size). For example, in Figure D-4(b) the distribution curve of the smaller air-bubbles (say ch_a < 10mm) matches a log-normal distribution[a], however the number of large bubbles is underestimated by the log-normal curve. A similar pattern is observed for the water-droplet curve in Figure D-4(a), although the range of chord-lengths matched by the log-normal curve is greater (say ch_w < 20mm).

Conversely, in the lower nappe interface the deviation from the 'standard' probability distribution with increasing mean chord-length is more evident in the water-droplet distribution than the air-bubble distribution. Interestingly, only two of the five flow conditions investigated displayed this trend in the lower interface, while the remaining three showed good agreement regardless of the mean chord-length.

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[a] A 'modified' log-normal curve is used in Figure D-4 to show that the smaller chord-lengths are well represented by a log-normal curve. The modified curve simply multiplies the standard log-normal pdf and cdf (Equation (D-5)) by a scaling factor (< 1). This artificially removes a certain percentage of chord-lengths from the sample distribution. The modified log-normal curve then provides a good match of both the experimental pdf and cdf of small chord-lengths. An additional probability function, representative of the larger chord-lengths, must be added to obtain the true distribution.

D.1.4 A Surface Wave Model

From data measured with a fixed-location intrusive probe, such as a conductivity probe, it is difficult to determine whether the discrepancies between the behaviour of air-bubbles and water-droplets are a function of normal bubble and droplet formation processes (e.g. shear stresses, surface tension etc.), or if these result from other influencing factors. In other words, is the observed chord-length distribution the ‘true’ probability function realised by air-bubbles and water-droplets at a particular air concentration? Inconsistencies, such as the disparity between the behaviour at the upper and lower nappe interfaces, and the fact that the observed trends are often inconsistent even between points in close proximity, suggest that the measured data is influenced by other factors.

Although there is no single discrete water surface, or air-water boundary, there is nevertheless a noticeable fluctuation, or wavy pattern, visible at the free surface downstream end of the step. Consider the air-water structure shown in Figure D-5, which is essentially a free surface wave superimposed upon a bubbly flow, with some spray above. A conductivity probe recording at fixed point in space cannot differentiate between an air-bubble (a pocket of air completely surrounded by water) and a wave formation. A probe located within the wavy region will detect numerous small bubbles (which may have a particular size distribution), together with a number of wave-related chord-lengths, which may have an order of magnitude several times greater than the bubbles. The effect of surface fluctuations must dissipate towards the invert (at the channel bottom, the wave effect must be nil). If the bubbly region is thicker than the wave amplitude then the bubbly flow pattern detected by a probe close to the invert will not be affected to near the same degree as closer to the ‘free surface’.

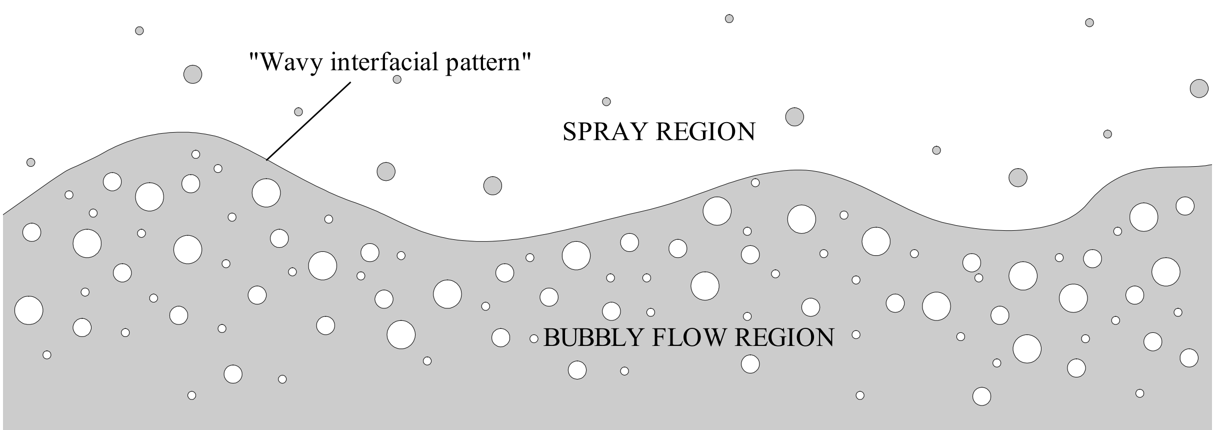

Figure D-5 Hypothetical air-water structure at a free surface

The diagram shown in Figure D-5 is a hypothetical situation, intended to illustrate the effect of a surface wave. It is probable that there is no discrete air-water free surface in the experimental flow situation, but rather a smooth transition from water to air, as well as the superposition of waves of different wave lengths and celerity.

It is hypothesised that the data obtained by a conductivity probe is influenced by surface wave patterns and other short-term instabilities/fluctuations. The effects on the flow properties recorded by a fixed-location probe resulting from a cyclic change in flow depth were investigated using a numerical model. (Note that, despite the absence of a discrete water surface, the cyclic variation of flow depth with time will still be referred to as a surface wave). The model developed herein was designed to specifically model a 'surface wave' in a smooth-invert open channel, such as might be encountered at the downstream end of the step. Nevertheless, other flow situations, such as the cyclic oscillation of the free-falling nappe, may result in similar modifications to the flow properties recorded by a fixed probe.

D.2 THE NUMERICAL MODEL

The purpose of the numerical model is to investigate the effect that a free-surface wave has on the data recorded by a fixed-location probe. There is little, if any, analysis of physical model data of this nature to be found in current literature. Since the recorded data may (or may not) be influenced by surface waves, it is necessary to work backwards from the result to estimate the input variables. The model is developed based upon fairly broad assumptions regarding the properties of the air-water flow and their variation with time. Qualitatively, some useful information may be derived nonetheless.

The approach of the model is as follows:

1. Assume a set of 'base' flow properties for the transition from water to air, independent of any surface waves (i.e. properties that the air-water mixture would display in the absence of any surface waves).
2. Superimpose a wave pattern on the base properties.
3. Compare the 'wave modified' flow properties with the original 'base' flow properties to determine the influence of the wave pattern on the output results.

The numerical model simulates the flow of a multiphase fluid past a probe by generating a stream of successive air-bubble and water-droplet chord-lengths, such as would be recorded by a conductivity probe or similar device. The parameters used to generate the 'signal' are then modified in response to a waveform oscillation of the water depth. The basic parameters, their mutation in response to the 'surface wave', and the 'signal' generation procedure are detailed in Sections D.2.1, D.2.2 and D.2.3 respectively.

D.2.1 'Base' Properties of the Air-Water Transition

The 'base' properties of the air-water transition are the standard properties that the multiphase fluid would display in the absence of any form of free-surface wave or flow depth fluctuation. Considering that the recorded data may be affected by wave interference, it is necessary to examine the data and use realistic assumptions to estimate the underlying base properties.

D.2.1.1 Air Concentration Distribution

A number of models have been developed to describe the time-averaged air-concentration profile due to free surface aeration on inclined chutes, including WOOD (1984) and CHANSON (1995). These models have a theoretical basis, and both are found to offer a reasonable, although not perfect, approximation of the air-concentration profile at the end of the step well downstream of the drop. Unless stated otherwise, the presented analysis uses the model of WOOD, which offers a slightly better representation of experimental air-concentration profiles, particularly at high air concentrations.

(D-7) WOOD (1984): $$C = \frac{B'}{B' + \exp\left(-G'\cos\alpha\left(\frac{z}{z_{90}}\right)^2\right)}$$

(D-8) CHANSON (1995): $$C = 1 - \tanh^2\left(K' - \frac{1}{2D'}\frac{z}{z_{90}}\right)$$

where z is the elevation measured perpendicular to the invert, C is the time-average air concentration at elevation z, and z_{90} is the depth where the air concentration is 90%. B', $G'\cos\alpha$, K' and D' are functions of the mean (depth-average) air concentration only. The models of WOOD (1984) and CHANSON (1995) are discussed in greater detail in Appendix A.2, including standard values for B', $G'\cos\alpha$, K' and D'.

D.2.1.2 Velocity Profile

Several researchers have investigated the velocity distribution of self-aerated flows on chutes and spillways, with CAIN and WOOD (1981) suggesting that the velocity can be approximated using a power law distribution as:

(D-9) $$\frac{V}{V_{90}} = \left(\frac{z}{z_{90}}\right)^{1/n}$$

where V_{90} and z_{90} are the velocity and flow depth corresponding to 90% air concentration. This result has been validated for model and prototype data of air-water open channel flows by several other researchers, including CHANSON (1989), WOOD(1991) and CHANSON and CUMMINGS (1996), with the latter work proposing a value of 6 for the exponent n. Experimental data from the current study at the downstream end of the step shows reasonable agreement with this approximation, with $5 < n < 6$.

D.2.1.3 Bubble Frequency Distribution

The bubble frequency may be approximated using the modified parabolic relationship outlined in Section D.1.2. It must be noted that the constant λ_w/λ_a, and consequently the correction factor $\alpha(C)$, appears to be modified by the surface wave. This relationship was investigated using the wave model and the results are presented in Section D.3.2.

D.2.1.4 Bubble and Droplet Chord-Lengths Distributions

The mean chord-length of air-bubbles and water-droplets at a distance z from the invert can be determined as:

(D-10) $$(ch_a)_{mean} = \frac{V\,C}{F_a} \qquad \text{and} \qquad (ch_w)_{mean} = \frac{V(1-C)}{F_a}$$

where C, V, and F_a are respectively the air concentration, velocity and bubble frequency at elevation z. The air concentration, velocity and bubble frequency profiles can be determined from Equations (D-7) (or (D-8)), (D-9) and (D-1) respectively, and can be substituted into Equation (D-10) to directly calculate the mean air-bubble and water-droplet chord-lengths as a function of z/z_{90}.

It is possible to generate a random bubble size if the probability distribution function of the chord-lengths is known. For the numerical model, it is assumed that both the air-bubble and the water-droplet chord-length distributions can both be represented by a log-normal probability distribution with mean M and standard deviation S (where $M = (ch_a)_{mean}$ and $S = S_a$ for air-bubbles and $M = (ch_w)_{mean}$ and $S = S_w$ for water-droplets). Random chord-lengths can be generated using the probability distribution as:

(D-11) $$\frac{ch}{M} = \exp\left(M' + normsinv\left(Rand\right) S'\right)$$

where *Rand* is a random number between 0 and 1 and the function *normsinv* returns the inverse of the standard normal cumulative distribution (mean = 0, std. dev. = 1) given by:

(D-12) $$F\left(\chi_u ;0,1\right) = \int_{-\infty}^{\chi_u} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{\chi^2}{2}\right) d\chi$$

M' and S' are calculated as:

(D-13) $$M' = -\tfrac{1}{2}\ln\left(\left(\frac{S}{M}\right)^2 + 1\right) \quad \text{and} \quad S' = \sqrt{\ln\left(\left(\frac{S}{M}\right)^2 + 1\right)}$$

For simplicity, it is assumed in the model that the ratio S/M remains constant and independent of air concentration. Experimental data suggest that this is incorrect, and that the ratio typically increases with mean chord-length size (i.e. S/M increases with C for air-bubbles and decreases for water-droplets). However, this variation of S/M is likely to be strongly affected by any surface wave, and it is impossible to determine the exact form of this relationship from the potentially wave-affected experimental data.

D.2.2 Modelling of Surface Roughness

The base air-concentration profiles (WOOD 1984 or CHANSON 1995) imply that there is not an absolute air-water free-surface, but rather the time-average air concentration increases with distance from the invert in a smooth transition from water to air. The profiles represent the air concentration at a given depth, averaged over an infinite time. There is currently no information on how the air concentration varies in the short-term, e.g. the time-scale of a surface wave. It is necessary to make a number of assumptions for the numerical model, regarding how a surface wave affects the basic flow parameters.

D.2.2.1 Modification of the Air Concentration Distribution

Because there is no discrete free-surface interface, the 'surface wave' must be considered as a variation of the air concentration profile described in Section D.2.1.1. The profile may be described in terms of two basic parameters: the depth-average air concentration, C_{mean}, and a depth scale, typically represented as either d, the mean flow depth, or z_{90}, the elevation corresponding to C = 90%. Exactly how a 'surface wave' affects these parameters is unknown. Two examples are shown in Figure D-6. The first example shows a large variation in z_{90} while the effect of the wave decreases close to the invert, i.e. $\delta z_{90} > \delta z_{10}$, where δz_{90} and δz_{10} are the deviation of the depths corresponding to C = 90% and C = 10% respectively. The second example, described as a *bubble surge*, shows only a small variation in z_{90} but a large variation in the bubble-penetration depth, i.e. $\delta z_{10} > \delta z_{90}$.

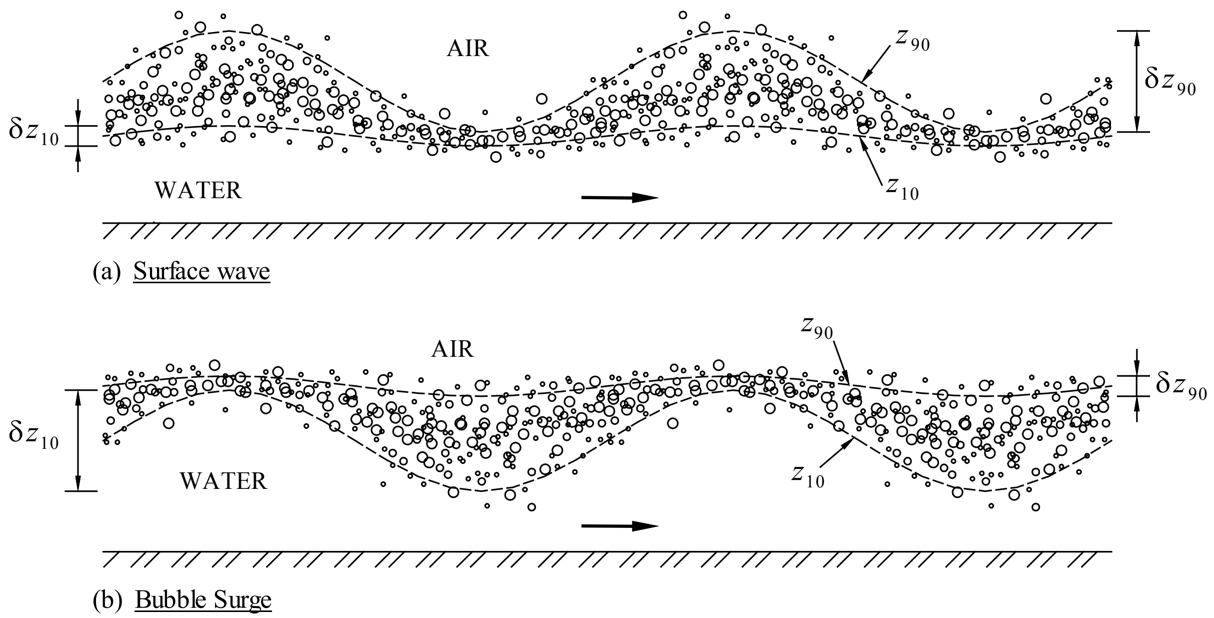

Figure D-6 Unsteady air-concentration profiles

For simplicity, the following assumptions are used in the numerical model:

1. The depth-average air concentration, C_{mean}, remains practically constant, where C_{mean} is defined in terms of z_{90} as:

(D-14) $$C_{mean} = \frac{1}{z_{90}} \int_0^{z_{90}} C \, dz$$

where z is the elevation, C is the time-average air concentration at z, and z_{90} is the flow depth corresponding to C = 90%. From this assumption, the values of B', $G'\cos\alpha$, K' and D' used in Equations (D-7) and (D-8) remain independent of the depth change.

2. The variation of flow depth, δ, is linearly proportional to the flow depth, z, e.g. if z_{10} corresponds to $\frac{1}{2}z_{90}$, the variation at z_{10} will be equal to half of that at z_{90}.

(D-15) $$\frac{\delta}{z} = \frac{\delta_{90}}{z_{90}}$$

The variation of the air-concentration profile with time resulting from these assumptions is shown in Figure D-7 for a sinusoidal wave pattern. Although the assumptions are by no means perfect, lack of evidence makes more complex assumptions difficult to justify.

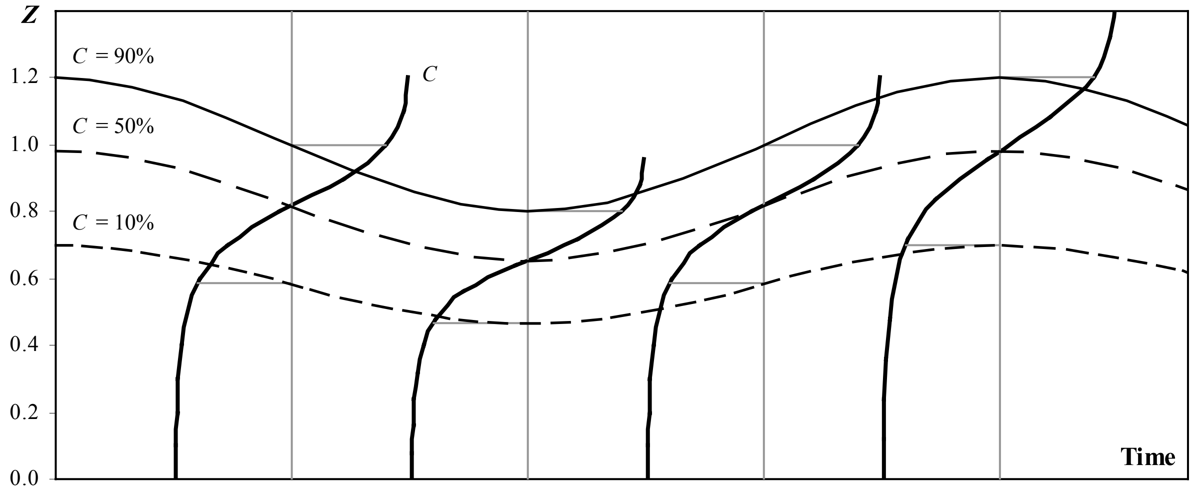

Figure D-7 Variation of the air-concentration profile with time

It is assumed that the free surface fluctuations take the form of sinusoidal waveforms, with a wavelength and amplitude that deviate about a specified mean. To achieve this, the oscillation is modelled as a series of alternating positive and negative 'half-sine-waves', with the amplitude and wavelength of subsequent half-waves being semi-random. The deviation of z_{90} with distance (or alternatively, with time $t = x/V$ past a fixed point) is given as:

(D-16) $$z_{90} = \bar{z}_{90} + A'\sin\left(2\pi\frac{(x - x_0)}{W'}\right)$$

where $\bar{z}_{90}$ is the mean value for z_{90}, x_0 is the location of the start of the half-wave and A' and W' are the amplitude and wavelength of the wave (Figure D-8).

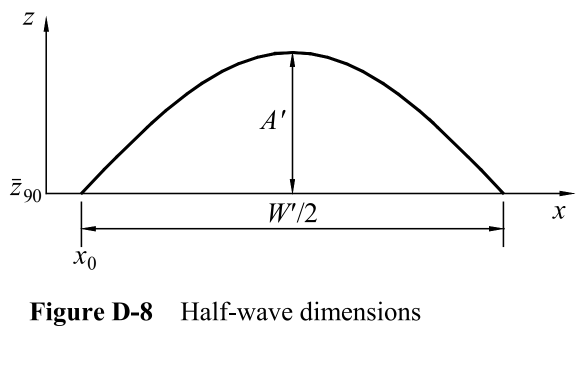

Figure D-8 Half-wave dimensions

In the absence of more pertinent data, the magnitude of A' and W' are modelled as:

(D-17) $$A' = \{\text{sign}\}\left|normsinv(Rand)\right| A$$

(D-18) $$W' = 0.8\left|normsinv(Rand)\right| W$$

where *normsinv* returns the inverse of the standard normal cumulative (Equation (D-12)), *Rand* [b] is a random number between 0 and 1 and {sign} is the opposite sign of the previous half wave. *W* is the wavelength of an average wave (i.e. two half-waves), while *A* is a constant representative of the deviation of the wave pattern from the mean. The resulting wave pattern has the following features:

- The wavelength and (magnitude of the) amplitude of the wave can be represented by a Weibull probability distribution. The mean of W' is equal to W; and
- The deviation about the mean, $z_{90} - \bar{z}_{90}$, can be represented by a normal probability distribution with a standard deviation of $S = A$.

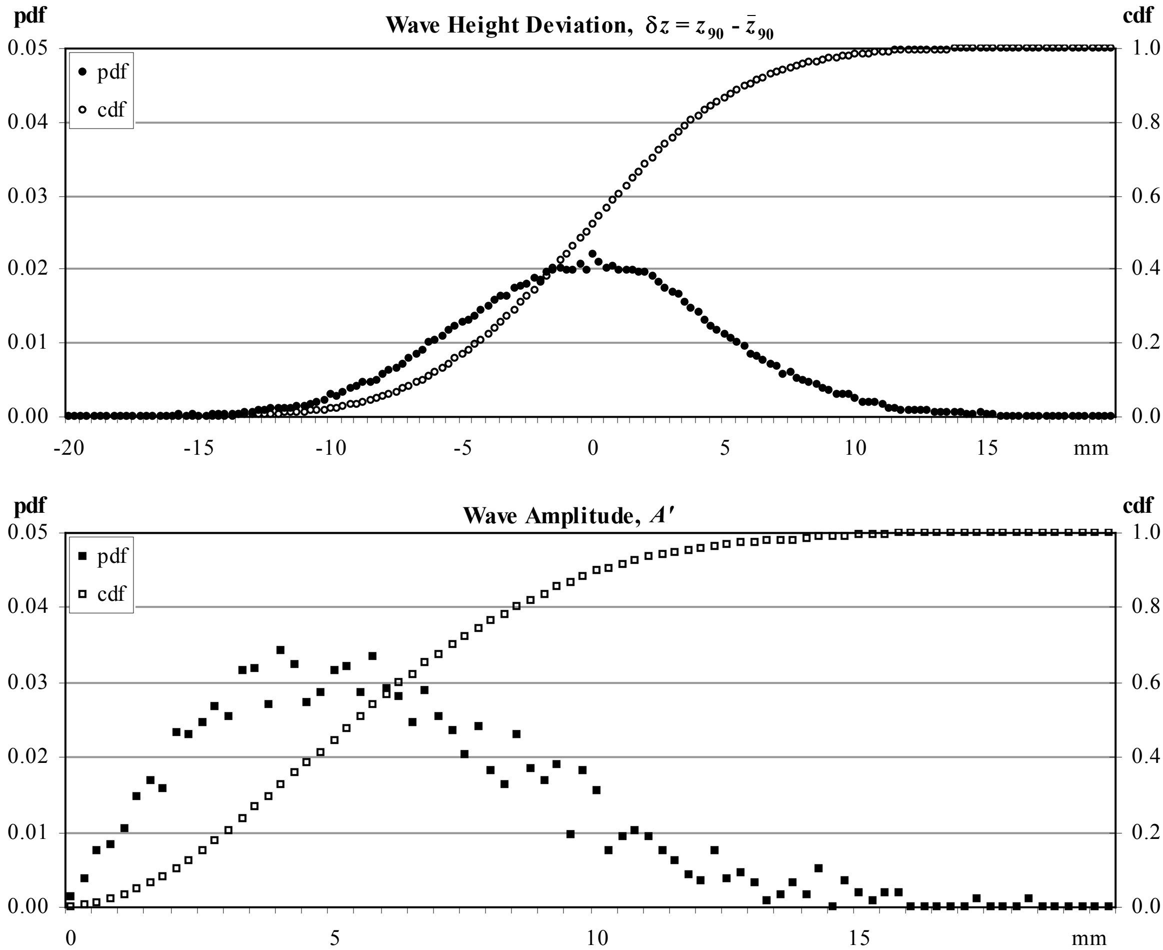

Figure D-9 Probability distribution functions of (a) wave position and (b) amplitude

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[b] The same value of *Rand* is used in Equations (D-17) and (D-18) for each half-wave.

Figure D-9(a) and (b) show the Probability Density Function (p.d.f) and Cumulative Distribution Function (c.d.f) of the wave amplitude, A', and wave height deviation, $\delta z = z_{90} - \bar{z}_{90}$, respectively, generated for a wave of A = 10mm. A sample of the wave pattern generated by Equations (D-16) to (D-18) is shown in Figure D-10.

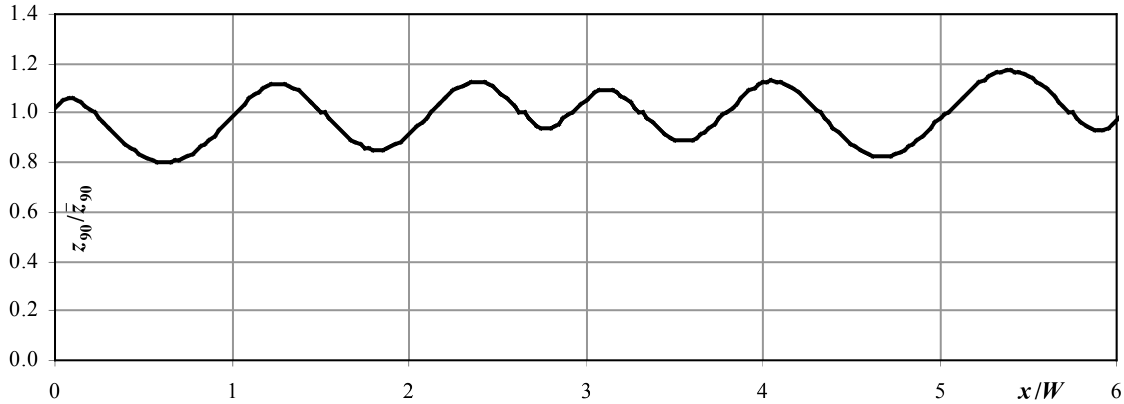

Figure D-10 Sample of the generated wave pattern

D.2.2.2 Modification of the Velocity Profile

The variation of velocity with time due to a surface wave is unknown. Considering that clearwater flow depth, $d = q/V_{\text{mean}}$, a variation of flow depth may correspond to a variation of flowrate, q, average velocity, V_{mean}, or both. Testing of the model using the alternatives of:

- flowrate, q, is assumed to be constant, while the mean velocity varies inversely with the wave-induced variation of flow depth, and
- depth-average velocity, V_{mean}, is assumed to be constant while the flowrate varies with the flow depth,

indicated that the assumption for velocity variation has little overall effect on the results obtained from the model.

For simplicity, the numerical model assumes that the depth-average velocity is constant. The velocity, V, can be calculated from Equation (D-9) for a varying z_{90} as:

(D-19) $$\frac{V}{\overline{V}_{90}} = \left(\frac{\bar{z}_{90}}{z_{90}}\right)\left(\frac{z}{z_{90}}\right)^{1/n}$$

where z_{90} is the depth corresponding to C = 90%, $\bar{z}_{90}$ is the mean value of z_{90}, $\overline{V}_{90}$ is the mean velocity at $\bar{z}_{90}$, and n is a constant in the order of $5 < n < 6$ for the current study.

D.2.3 Signal Generation Procedure

The purpose of the model is to generate a stream, or length, of bubble and droplet chord-lengths equivalent to a flow past a fixed probe. The procedure used is fairly simple:

1. Generate a random air-bubble size, $ch_a/(ch_a)_{mean}$ from Equation (D-11). Since it is assumed that S/M for the distribution remains constant, this value will remain independent of variations in the flow depth.
2. Progress along the length of the bubble in sufficiently small steps, simulating the progress of the bubble past a fixed probe. At each point, calculate the flow depth, z_{90}, which varies with distance in accordance with Equation (D-16).
3. Calculate the new mean bubble size, ch_a, corresponding to each new flow depth using Equation (D-10). The required values of C, V and F_a can be calculated from z/z_{90} using Equations (D-7) (or (D-8)), (D-19) and (D-1) respectively.
4. Compare the modified chord-length with the current probe location. If the location is now beyond the end of the bubble chord-length, the bubble has 'ended'.
5. Once the air-bubble has 'ended', generate a random water-droplet size, $ch_w/(ch_w)_{mean}$. Repeat the procedure for successive bubbles and droplets.

Using the approximations outlined in the previous sections, the entire system can be modelled using the constants listed in Table D-1.

Table D-1 Description of constants required for the model

Constant	Description
z	Elevation of the 'probe' relative to the invert
$\bar{z}_{90}$	Mean depth corresponding to 90% air concentration
Model	Model used to approximate the base air-concentration distribution. Typically WOOD (1984) or CHANSON (1995)
C_{mean}	Depth-average air concentration in terms of z_{90}. Used to calculate the constants B' and $G'\cos\alpha$ or K' and D' used in WOOD and CHANSON respectively
$\bar{V}_{90}$	Mean velocity at the depth corresponding to $\bar{z}_{90}$
n	Power law constant, typically $5 < n < 6$
F_{max}	Maximum bubble frequency
λ_w/λ_a	Constant used in determining F_a vs. C relationship
b	Constant used in determining F_a vs. C relationship
W	Average wavelength of the flow depth oscillation
A	Scaling factor for the amplitude of the flow depth oscillation ($A = S_{90}$, the standard deviation of the location of z_{90})
$(S/M)_{air}$	Ratio of standard deviation to mean of the air-bubble chord-length distribution
$(S/M)_{water}$	Ratio of standard deviation to mean of the water-droplet chord-length distribution

Notes: The values $\bar{z}_{90}$, C_{mean} and F_a are used for determining the base air-concentration and bubble-frequency distributions only, i.e. in absence wave effects. The time-averaged distribution of the model output will be modified by the effects of the depth oscillation, and hence have different values.

D.3 RESULTS

A random sample of air-bubble and water-droplet chord-lengths, such as may be recorded by a fixed probe, were generated by the numerical model using the procedure outlined in Section D.2.3 above. These samples were used to investigate the effect of an oscillation of water depth on the air-water flow properties, such as air-concentration and bubble-frequency distributions at a vertical cross-section and the air-droplet and water-bubble chord-length distributions at a fixed point. The changes produced by variation of the parameters outlined in Table D-1 were also investigated. The results were then compared with experimental data. Unless otherwise stated, the experimental data shown in Sections D.3.1 to D.3.3 was obtained at x = 1.8m for Experiment DT3 (i.e. the downstream end of the step).

D.3.1 Effect on the Air-Concentration Profile

A systematic investigation using a wide range of parameters in the numerical model shows that the air-concentration profile of the wave-affected flow is a function primarily of the base air concentration distribution (i.e. $\bar{z}_{90}$ and C_{mean}) and the amplitude of the superimposed wave oscillation, A (highlighted in grey in Table D-2). The wavelength of the surface wave, the bubble-frequency distribution (F_{max}, λ_w/λ_a, b) and the chord-length distribution (($S/M)_{air}$, $(S/M)_{water}$) are all found to have little significant influence on the shape of the air-concentration distribution.

Table D-2 Constants used for investigation of air-concentration and bubble-frequency distributions

Constant		**A = 0**	**A = 5**	**A = 10**	**A = 15**
$\bar{z}_{90}$	[mm]	57.2	57.0	55.2	54.0
Model		WOOD	WOOD	WOOD	WOOD
C_{mean}		0.220	0.217	0.205	0.180
$\bar{V}_{90}$	[m/s]	3.38	3.38	3.38	3.38
n		5.5	5.5	5.5	5.5
F_{max}	[Hz]	295	310	330	390
λ_w/λ_a		1.0	1.0	1.0	1.0
b		0.4	0.4	0.4	0.4
A	[mm]	0	5	10	15
W	[mm]	-	200	200	200
$(S/M)_{air}$		1.5	1.5	1.5	1.5
$(S/M)_{water}$		1.5	1.5	1.5	1.5

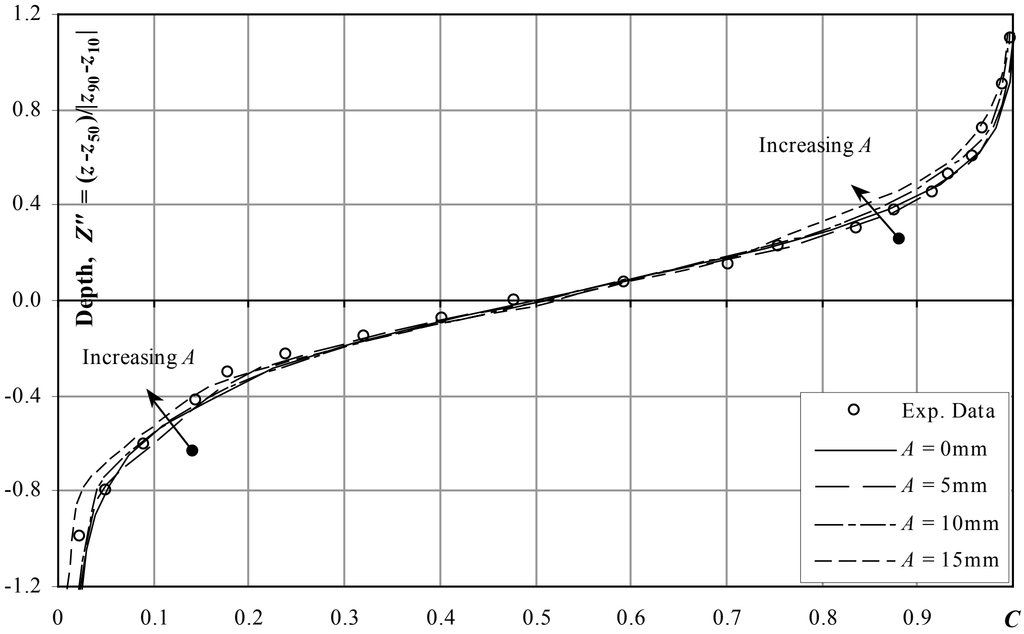

Figure D-11 Modification of the air-concentration distribution with wave amplitude

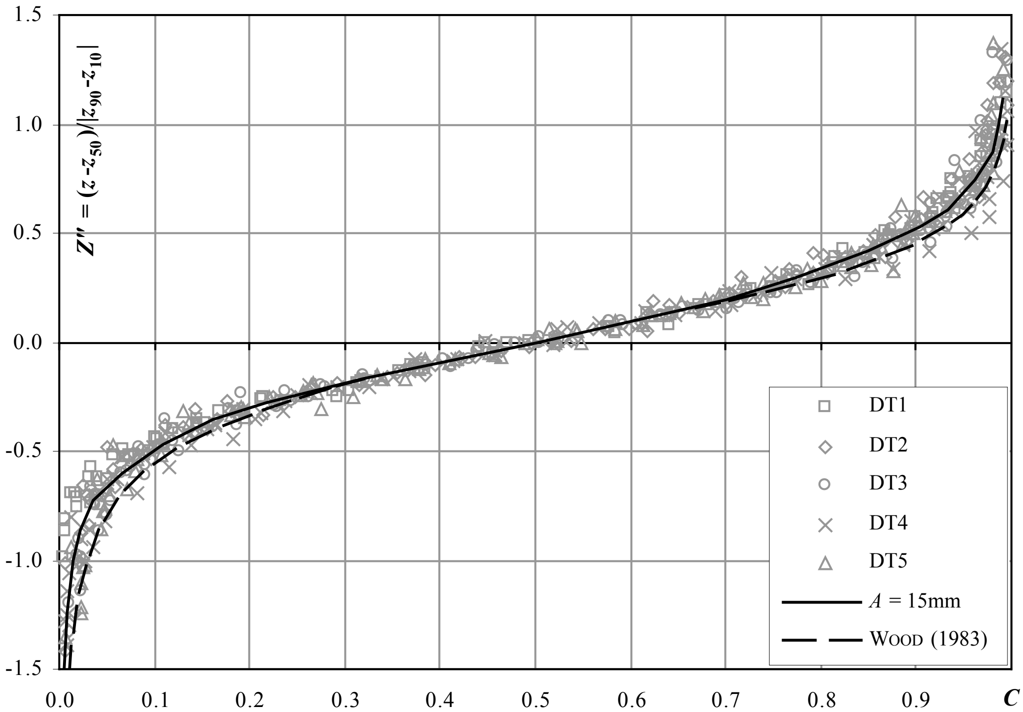

Figure D-12 Comparison of the wave modified profile with experimental data (at x = 1.8m)

A comparison of the time-average air-concentration distribution is made for a range of wave amplitudes, with the parameters used in the model listed in Table D-2. The values of $\bar{z}_{90}$ and C_{mean} are selected to equate $\bar{z}_{90}$ and $\bar{z}_{10}$ with the experimental data. The results[c] are shown in

[c] The data obtained are the product of random generation, hence there is some scatter in the values obtained.

Figure D-11. The effect of the wave action is to 'stretch' the base air-concentration distribution. The effect is amplified at increased distance from the invert, where the magnitude of the oscillation is greater (amplitude $\propto z/z_{90}$). The end result is that, with the scaling used in Figure D-11 and Figure D-12, the distance ($z_{90} - z_{50}$) is increased relative to ($z_{50} - z_{10}$) when compared to the original base distribution. This agrees favourably with the majority of the air-concentration profiles observed at the downstream end of the step, as shown in Figure D-12.

D.3.2 Effect on the Bubble-Frequency Distribution

The modified parabolic relationship, Equation (D-1), describes the relationship between bubble frequency and time-average air concentration at a cross-section. It is based on a simplified analogy – that the air-water mixture consists of a series of discrete air and water 'elements', of average length λ_a and λ_w respectively. The bubble frequency can be directly related to the probability that several elements of the same type occur consecutively, and hence merge to form a single air-bubble or water-droplet. While not strictly realistic, the analogy nevertheless results in a good representation of the relationship observed in the experimental data. See Appendix C for more details.

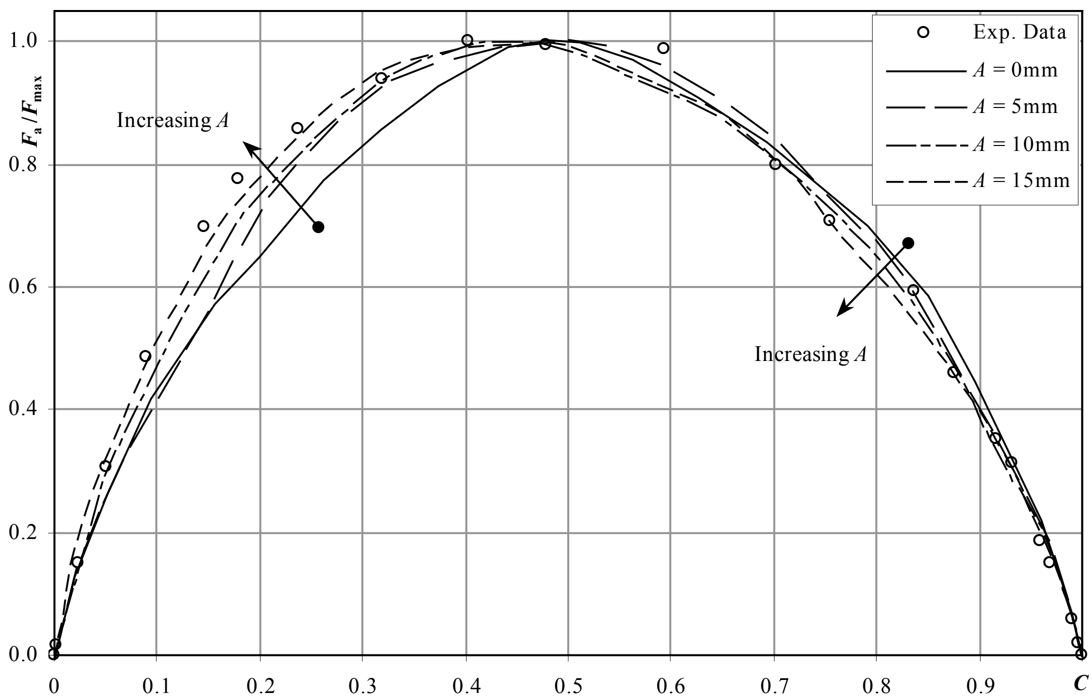

Figure D-13 Modification of the bubble-frequency distribution with wave amplitude

The correction factor $\alpha(C)$ in the modified parabolic relationship accounts for the air and water 'elements' having a different average length, i.e. $\lambda_a \neq \lambda_w$. The effect of this imbalance is to skew the bubble-frequency distribution, such that the maximum bubble frequency does not occur at $C = 0.5$. The effects of a wave pattern on the bubble-frequency distribution are investigated using the model conditions listed in Table D-2 above. The ratio λ_w/λ_a, and hence the factor $\alpha(C)$, is kept constant and equal to unity. The results are shown in Figure D-13.

Since the curves are compiled from discrete, randomly generated data sets, some scatter is observed. There is nevertheless a clear trend showing that the air concentration corresponding to the maximum bubble frequency, C_{Fmax}, decreases as the wave amplitude increases. This would imply that the presence of a depth oscillation does play some part in the unsymmetrical shape observed in the bubble-frequency distributions from the experimental data (which is currently compensated for by the correction factor $\alpha(C)$ in the modified parabolic relationship; see Appendix C). It is impossible to determine whether the shape is solely the result of waves or if other factors, such as surface tension, buoyancy, etc. also have some influence.

The results show a decrease in C_{Fmax} with increased wave amplitude, corresponding to a ratio $\lambda_w/\lambda_a > 1$. In some situations a ratio of $\lambda_w/\lambda_a < 1$ is observed in the experimental data, which cannot be explained using the surface wave form adopted for the model (see Section D.2.2.1). The numerical model assumes that the effect of the surface wave decreases close to the invert, i.e. $\delta z_{90} > \delta z_{10}$, where δz_{90} and δz_{10} are the deviation of the depths corresponding to $C = 90\%$ and $C = 10\%$ respectively (e.g. Figure D-6(a)). A ratio of $\lambda_w/\lambda_a < 1$ may be the result of an oscillation of the bubble-penetration depth, such as may be caused by a surge of bubbles progressing down the channel, i.e. $\delta z_{10} > \delta z_{90}$ (e.g. Figure D-6(b)).

D.3.3 Effect on the Chord-Length Distribution

A hypothetical horizontal section through a wave-affected flow (e.g. Figure D-6) is shown in Figure D-14. The wave pattern could be expected to introduce a number of 'large' chord-lengths into what would otherwise be expected to be a relatively uniform mixture. Whether the wave-induced large chord-lengths are air or water (or either) would depend on whether the flow resembles more closely Figure D-6(a) or (b).

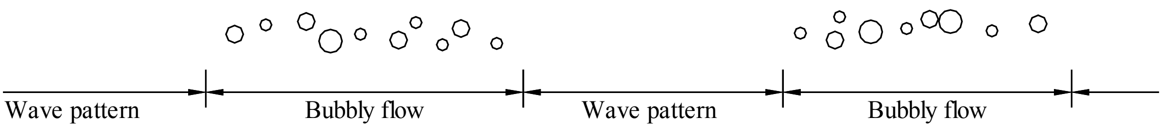

Figure D-14 Section through a wave-affected flow

The model characteristics listed in Table D-3 are used to investigate the effect of a surface wave on the air-bubble and water-droplet chord-length distribution. The values of $\bar{z}_{90}$ and C_{mean} are selected to equate $\bar{z}_{90}$ and $\bar{z}_{10}$ with the air-concentration distribution observed on the centreline at x = 1.8m for Experiment DT3, while the values of F_{max} and λ_w/λ_a are chosen to match the observed bubble-frequency distribution (highlighted in grey in Table D-3).

Table D-3 Constants used for investigation of chord-length distributions

Constant		***A* = 0**	***A* = 5**	***A* = 10**	***A* = 15**	***A* = 20**
$\bar{z}_{90}$	[mm]	57.2	57.0	55.2	54.0	51.2
Model		WOOD	WOOD	WOOD	WOOD	WOOD
C_{mean}		0.220	0.217	0.205	0.180	0.150
$\bar{V}_{90}$	[m/s]	3.38	3.38	3.38	3.38	3.38
n		5.5	5.5	5.5	5.5	5.5
F_{max}	[Hz]	295	310	330	390	500
λ_w/λ_a		1.5	1.3	1.18	1.0	1.0
b		0.4	0.4	0.4	0.4	0.4
A	[mm]	0	5	10	15	20
W	[mm]	-	200	200	200	200
$(s/M)_{air}$		1.4	1.35	1.3	1.2	1.0
$(s/M)_{water}$		1.4	1.35	1.3	1.2	1.0

The results from the model, shown in Figure D-15, suggest that the chord-length distribution is modified significantly by the presence of surface waves. The consequence of the wave is that, as the mean chord-length increases, the percentage of 'large' bubble chord-lengths in the chord-length distribution becomes increasingly greater than would be predicted by the log-normal distribution. The percentage of large chord-lengths increases with both wave amplitude and wavelength.

Unfortunately, there are too many unknown variables and simplifications in the model to accurately model the chord-length distributions across a complete section using the basic modelling techniques described in this section. Nevertheless, the chord-length distributions produced by the model display distinct trends that resemble the behaviour of the experimental data. These results would appear to confirm the hypothesis that the experimental data obtained with a conductivity probe is influenced by surface oscillations.

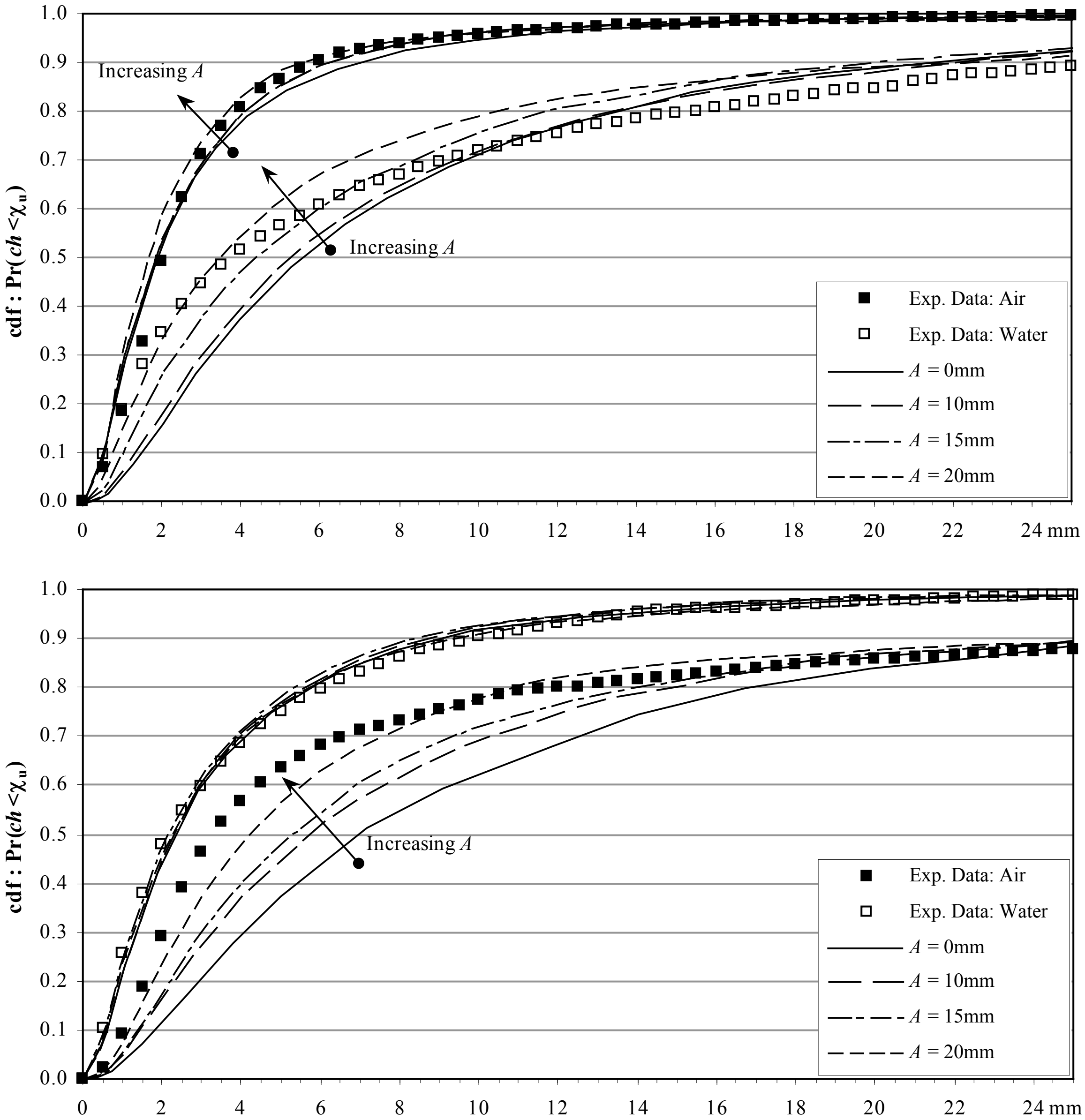

Figure D-15 Modification of air-bubble and water-droplet chord-length distributions with wave amplitude
(a) $C \approx 0.25$, $F_a \approx 250$Hz
(b) $C \approx 0.75$, $F_a \approx 200$Hz

D.4 SUMMARY

A fixed location probe such as a conductivity or optical probe detects air-water interfaces passing a single point. Subsequent interfaces are traditionally assumed to be the boundaries of discrete air-bubbles (pockets of air completely surrounded by water) or water-droplets (pockets of water completely surrounded by air). Differences are observed between the properties (frequency distribution, chord-length distribution etc.) of air-bubbles at high air concentrations and water-droplets at low air concentrations. The influence that a free-surface wave pattern superimposed onto a bubbly flow mixture has on the data recorded by a fixed-location probe was investigated using a simplified computer model to determine if these observed differences were the result of surface wave interference.

The numerical model simulates the flow past the tip of a fixed-location probe by assuming a set of 'base' properties for a bubbly transition from air to water, then modifying these properties in response to a periodic fluctuation of the flow depth. The base distributions of air concentration, velocity, bubble frequency and chord-length are assumed to comply with commonly accepted theoretical models.

Despite its many simplifications and assumptions, the model does suggest that surface waves or fluctuations of the flow depth can significantly influence the experimental data recorded by a conductivity probe. A number of general observations about the effect of surface waves can be made:

- A typical free-surface wave may be assumed to have negligible effect close to the step invert, with the magnitude of the effect increasing as the distance from the invert increases. Consequentially, the wave will tend to 'stretch' the base air-concentration distribution, with the influence amplified at increasing elevation. This is consistent with experimental data obtained on the single-step model. The influence of the surface wave is a function primarily of the amplitude of the wave.

- The presence of a fluctuating air-concentration profile has a significant influence on the relationship between bubble frequency and air concentration. A wave pattern that produces a variation in the air-concentration profile that increases with air concentration (i.e. $\delta z_{90} > \delta z_{10}$, where δz_{90} and δz_{10} are the deviation of the depths corresponding to C = 90% and C = 10% respectively, e.g. Figure D-6(a)), causes the bubble-frequency distribution to skew towards low air concentrations (i.e. F_{max} occurs at $C < 0.5$). A wave pattern where the variation decreases with air concentration (i.e. $\delta z_{90} < \delta z_{10}$, e.g. Figure D-6(b)), will presumably produce the opposite effect.

- The surface wave causes a modification of the air-bubble and water-droplet chord-length distributions, with the distributions containing an increased percentage of large chord-lengths. The amount of modification is a function of the amplitude and wavelength of the waves, as well as the mean chord-length. As the air concentration increases, the mean air-bubble chord-length increases and the number of large air-bubble chord-lengths introduced by the wave pattern correspondingly increases. Conversely, the mean water-droplet chord-length decreases as the air concentration increases, and the number of ‘additional’ large water-droplet chord-lengths decreases.

The presence of a free surface wave pattern superimposed over a bubbly flow with a smooth transition from water to air may be observed visually, but cannot be determined from the experimental conductivity probe data alone. Exact quantification of the separate bubble and wave properties, and their application in the numerical model, requires greater knowledge of the input parameters. Some information could be obtained through the use of high-speed video (e.g. pattern, amplitude, wavelength of the surface oscillation), self-correlation of the conductivity probe data (bubble grouping, cycle time) etc. This data would allow a more accurate representation of the structure of the air-water transition to be developed.

APPENDIX E – COMPARISON OF AERATION CALCULATIONS ON THE SINGLE AND MULTI-STEP CASCADES

E.1 INTRODUCTION

The current study performs calculations to estimate the aeration efficiency of a single step based on measured air-water flow data (interface area, velocity, flowrate etc.). When compared with estimates using the multi-step model data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000), the calculated aeration efficiency for the single-step model is approximately twice the efficiency calculated for Step 2 of the multi-step model despite comparable inflow conditions (depth and velocity) and geometry (step height and length) (see Section 7.5). There are a number of fundamental differences between the data from the current study and the multi-step data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000). The details of the experimental facilities used by the three studies are summarised in Table E-1.

Table E-1 Summary of apparatus and flow conditions

	Current Study	CONDON and ROWLANDS (1998)	EASTMAN and VAN SCHAGEN (2000)
Geometry:			
Model	Single-step	Multi-step	Multi-step (modified)
Step length	2.4m	2.4m	1.2m
Step height	0.143m	0.143m	0.071m
Channel width	0.25m	0.5m	0.5m
No. of steps	1	10	20
Measurement Locations:			
Transverse measurement locations [a]	Y = 0.0, 0.2, 0.4, 0.6, 0.8, 0.96	Y = 0.0 only	Y = 0.0 only
Measurement Device:			
Conductivity probe type	Double-tip	Single-tip	Single-tip
Scanning frequency	40kHz	6kHz	6kHz

Notes: a $Y = 2y/W$, i.e. $Y = 0$ is the centreline, $Y = 1.0$ is the sidewall

The single-step model was designed to emulate the geometry and flow conditions found at the first drop (i.e. on Step 2) of the multi-step model used in present study and the experiments of CONDON and ROWLANDS (1998). Despite this, there remain some fundamental differences between the two apparatus and calculation methods. The major differences are:

- **Measurement Probe**: The current study uses a double-tip conductivity probe with a very high scanning frequency (40kHz) on the single step model, whereas the data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) were obtained using a single-tip conductivity probe with a lower scanning frequency (6kHz). The double-tip probe is capable of detecting significantly smaller bubbles than the single-tip probe, and gives a better estimate of the *bubble frequency*. The effect of detected bubble frequency on aeration efficiency is discussed in Section E.2. Additionally, the double-tip probe enables measurement of the local flow *velocity*, while calculations based on the single-tip probe must be performed using the average flow velocity. This is discussed in Section E.3.

- **Geometry**: Results from the current study are based upon three-dimensional measurements, which incorporate the three-dimensional patterns on the step, such as the sidewall standing-wave and shockwaves. The experiments of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) are *centreline* measurements only. A comparison of centreline and cross-sectional average data is given in Section E.4. Although the single and multi-step apparatus feature identical step height and length, the width of the single-step model is half that of the multi-step cascade. The impact of the channel width is difficult to estimate given that CONDON and ROWLANDS (1998) only obtained centreline measurements.

E.2 COMPARATIVE PERFORMANCE OF THE DOUBLE-TIP AND SINGLE-TIP PROBES IN TERMS OF BUBBLE FREQUENCY

While the single-tip and double-tip probes provide essentially identical void fraction data for identical flow conditions, significant differences are observed in terms of bubble frequency. The experiments of the current study (on the single step model) are performed using a double-tip conductivity probe (Section 3.2.3) which has an inner electrode diameter of 0.025mm and a scanning frequency of 40kHz. The experiments by CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) on the multi-step model were performed using a single-tip probe (Section 3.2.2) with a 0.35mm inner electrode diameter and a scanning frequency of 6kHz. In short, the double-tip can detect bubbles an order of magnitude smaller than the single-tip probe.

The impact of this capability is illustrated in Figure E-1, where the maximum bubble frequency at each centreline section along the step is shown for Experiment DT3 from the current study (q_w = 0.105m²/s) and a similar flowrate (q_w = 0.11m²/s) from the data of CONDON and ROWLANDS (1998). The maximum bubble frequency detected by the double-tip probe within the spray region ($0.3 < x/L < 0.6$) is 20% greater than that detected by the single-tip probe. However, the difference between the two probes is much greater within the lower interface of the free-falling nappe, at nappe impact, and towards the downstream end of the step, at times over 150%. The different order of magnitude between regions is likely caused by differences in the typical air-bubble and water-droplet sizes found at each location. In regions of the flow containing a high percentage of small bubbles and/or droplets (e.g. < 1mm) the single-tip probe fails to detect the fine bubbles, and consequently returns a lower bubble frequency than the double-tip probe.

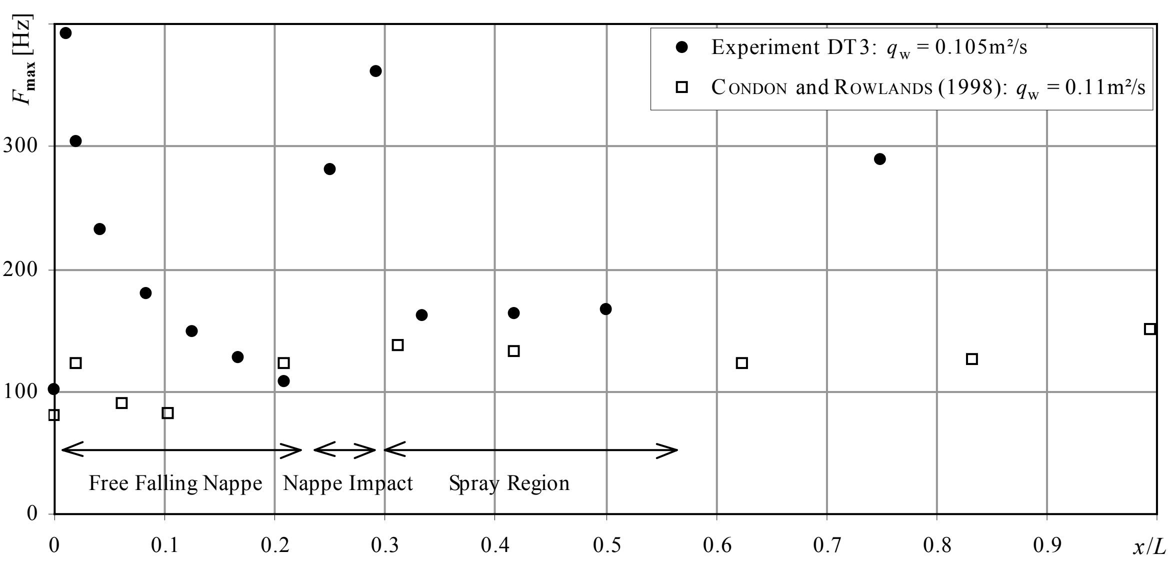

Figure E-1 Maximum bubble frequencies detected by the double-tip and single-tip probes downstream of the first drop (centreline data)

Such a direct comparison has limitations because the apparatus used for the investigations have slightly different configurations (channel width is the most obvious, however nappe ventilation, construction material and inflow conditions may also have some effect). However, CHANSON and TOOMBES (2000b) performed air-water measurements in a skimming flow situation down a 21.8° stepped cascade using both double and single-tip conductivity probes at identical locations and for identical flow conditions. Measurements at the step edges found that the time-average air concentrations recorded by the probes were similar, but the bubble frequencies recorded by the double-tip probe were between 25% to 70% higher than those recorded by the single-tip probe.

While the presence of a significant number of small bubbles or water-droplets may have little effect on the average air concentration, the effect on the specific interface area, and hence aeration efficiency, can be considerable. The rate of transfer for a volatile gas in a liquid may be written as:

(E-1) $$\frac{\partial C_{\text{gas}}}{\partial t} = K_{\text{L}}\, a\left(C_{\text{SAT}} - C_{\text{gas}}\right)$$

where K_L is the mass transfer coefficient or liquid film coefficient and C_{SAT} is the dissolved gas concentration in water at equilibrium. The specific interface area may be estimated as:

(E-2) $$a = \frac{4\, F_{\text{a}}}{V}$$

where V is the velocity and F_a is the bubble frequency. Equation (E-1) shows that the rate of gas transfer is directly proportional to the specific interface area, which in turn is directly proportional to the measured bubble frequency (Equation (E-2)). Any difference in the measured bubble frequency will be directly reflected in the calculated aeration efficiency.

E.3 APPROXIMATION OF THE MEAN FLOW VELOCITY

A single-tip conductivity probe cannot measure the velocity of the flow. For the experiments of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000), an average velocity was calculated based upon the clear-water flow depth at the centreline:

(E-3) $$V_{\text{d-CL}} = \frac{Q_{\text{w}}}{W\, d_{\text{CL}}}$$

where Q_w is the water flowrate, W is the width of the channel and d_{CL} is the clearwater flow depth at the centreline, defined as:

(E-4) $$d = \int_0^{z_{90}} (1 - C)\, dz$$

Using an average velocity calculated from Equation (E-3) introduces two sources of error:

- The velocity across the channel is NOT uniform. The velocity profile on the channel centreline can typically be approximated by a power law (see Section 6.4.2.2 and 6.4.3.2). The velocity at the sidewall is typically slower than the velocity at the centreline due to friction and the effects of the sidewall standing-wave and shockwaves (see Figure 6-28); and

- The clearwater flow depth at the centreline, d_{CL}, may not be representative of clearwater flow depth across the channel. For example, the clearwater flow depth in the spray region downstream of nappe impact is generally lower than the clearwater flow depth in the sidewall standing-waves, hence the calculated $V_{d\text{-}CL}$ will be greater than the actual cross-sectional average velocity. Conversely, the clearwater flow depth where the shockwaves intersect on the centreline is typically greater than at the sidewall (see Figure 6-26).

Figure E-5 shows the ratio of $V_{d\text{-}CL}$, the velocity calculated using the centreline clearwater depth, to the cross-sectional average velocity, $\overline{V}$, for the single-step channel data (the centreline data is a subset of the cross-sectional data). The velocity based on centreline depth can be up to 80% higher than the cross-sectional average within the standing-wave/spray region downstream of nappe impact ($0.3 < x/L < 0.6$, where L is the step length), while it tends to be slightly less than the cross-sectional average elsewhere.

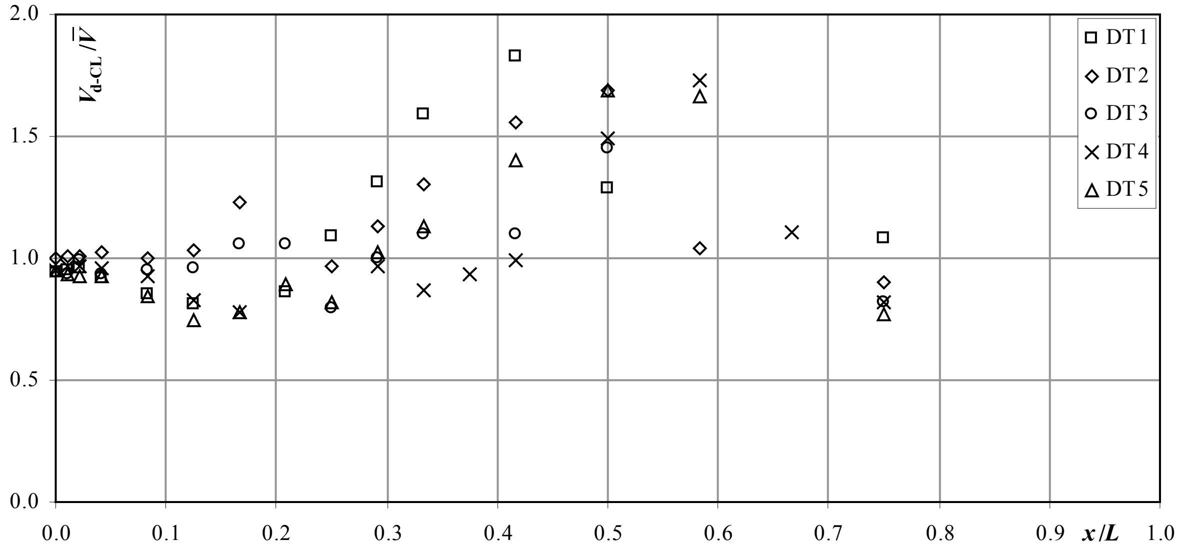

Figure E-2 Ratio of velocity calculated using centreline clearwater flow depth to average section velocity W = 0.25m, single-step model

The velocity is an important parameter for the calculation of the aeration efficiency. Both the specific interface area (Equation (E-2)) and the residence time on the step ($t = \Delta x/V$) are inversely proportional to the velocity. As a result:

$$E \propto \frac{1}{V^2} \qquad \textbf{(E-5)}$$

Consequently, any error or inaccuracy in the velocity calculation will be magnified in the aeration efficiency calculations.

E.4 COMPARISON OF CENTRELINE WITH CROSS-SECTION AVERAGE DATA

The experimental data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) were obtained on the centreline of the 500mm wide channel only, and it is assumed that these profiles are indicative of the cross-sectional average. In a very wide channel (two-dimensional flow) this may indeed be the case. Measurements at different locations across the single-step channel during the current study suggest however that the three-dimensional patterns (i.e. sidewall standing-waves and shockwaves) can significantly influence the cross-sectional average properties on the step, including the mean specific interface area.

Figure E-3 shows the mean (depth-average) specific interface area, a_{mean}, at vertical profiles on the centreline and next to the sidewall for Experiment DT4 on the single-step model. The data are presented in dimensionless form, where $\bar{a}$ is the cross-sectional average specific interface area. The centreline profile increasingly underestimates the cross-sectional average specific interface area within the free-falling nappe as air is entrained at the sides of the nappe more rapidly than on the centreline.

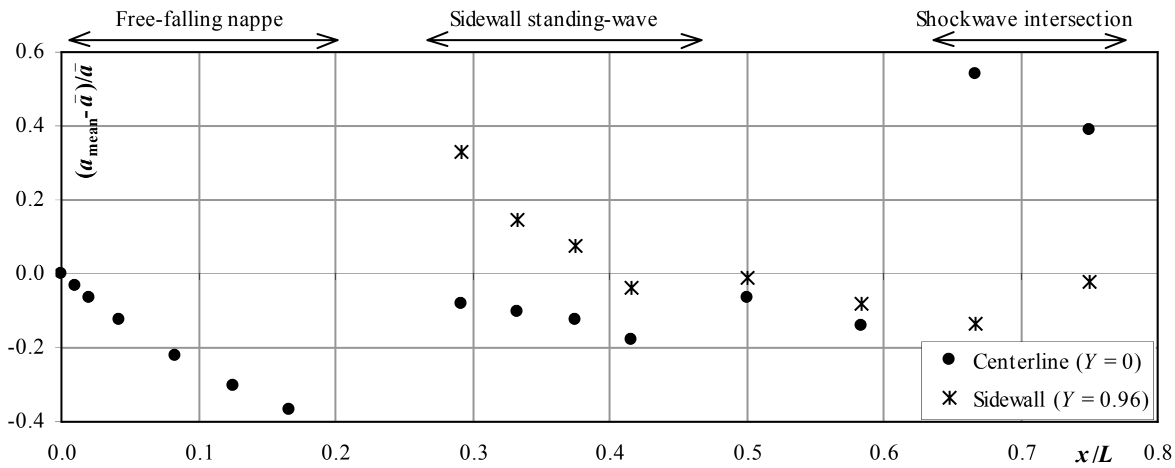

Figure E-3 Centreline and sidewall depth-average specific interface area relative to the cross-sectional average Exp. DT4, $d_0 = 24.3$mm, $V_0 = 3.59$m/s, $W = 0.25$m

The mean specific interface area in the sidewall standing-wave can be significantly higher than at the centreline, although the thickness of the standing-wave is relatively narrow. The centreline depth-averaged specific interface area is typically 10% to 20% lower than the cross-sectional average. Conversely, at the shockwave intersection the centreline specific interface area is significantly (over 50%) higher than the cross-sectional average, although the distance over which this occurs is relatively short.

E.5 OVERALL EFFECT OF USING CENTRELINE DATA ONLY

A comparison between the aeration efficiency for oxygen calculated using cross-sectional average values and the aeration efficiency calculated using centreline data only is shown in Figure E-4 for experiment DT3 on the single step model. The profile labelled '*Cross-Section Data*' is calculated using the complete double-tip probe data across the cross-section (i.e. bubble frequency, velocity etc.). The profile labelled '*Centreline Data Only*' is calculated using the bubble frequencies obtained at the centreline only (Section E.4), and using an average velocity calculated using the centreline clearwater depth, $V_{d\text{-}CL}$ (Section E.3). The centreline data used for the '*Centreline Data Only*' curve is a subset of the data used for the '*Cross-Section Data*' curve. There is no difference in the bubble frequency detection capacity of the probe (Section E.2), which has a significant impact on the calculated specific interface area and aeration efficiency.

Figure E-4 shows that the aeration efficiency predicted by the centreline data falls below the average data curve within the sidewall standing-wave region, before recovering somewhat at the shockwaves intersection.

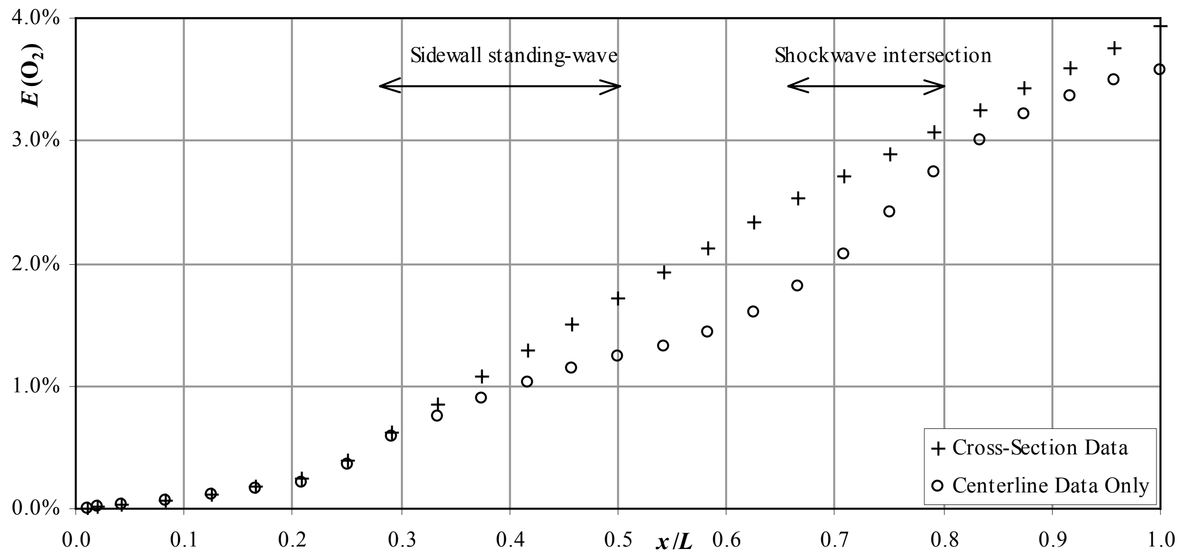

Figure E-4 Comparison of centreline and average oxygenation efficiency along the step
Exp. DT3, $d_0 = 29.6$mm, $V_0 = 3.75$m/s

A direct correlation cannot be simply estimated between efficiencies calculated using centreline and cross-sectional data. The ratio of aeration efficiency of a single step calculated using cross-sectional average data to efficiency calculated using centreline data is shown in Figure E-5 for Experiments DT1 to DT5. The curves follow a similar pattern; the centreline data underestimates the aeration efficiency in the spray region downstream of nappe impact before partially recovering at the shockwave intersection. However, the relative intensity of each of these components varies significantly depending upon the length of the free-falling nappe and the relative size, strength and location of the sidewall standing-wave and shockwave intersection. The flow conditions, the step configuration, and the location of the step on the cascade will all affect these factors. The results suggest that the centreline data may slightly overestimate the aeration efficiency, or underestimate the aeration efficiency by as much as 40%.

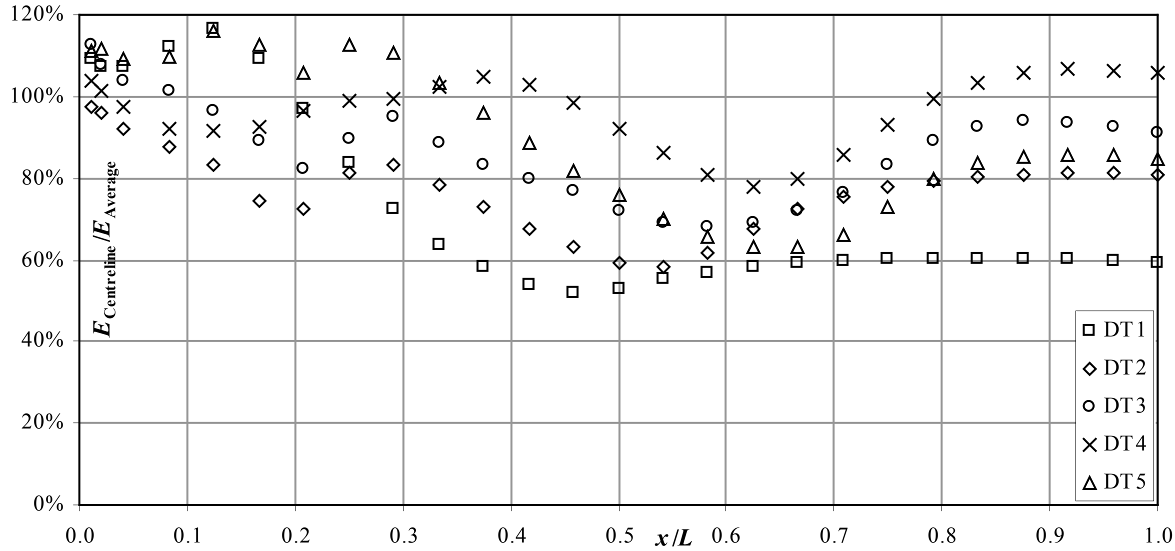

Figure E-5 Ratio of centreline to cross-sectional average aeration efficiency

E.6 DISCUSSION

The results shown in Section E.5 indicate that calculations based on centreline data will typically underestimate the aeration efficiency of the step. It must be highlighted that the data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) were obtained on a 500mm wide channel, while the results in Section E.5 are based on data obtained in a channel half that width. In the wide channel, the shockwave intersection on each step occurs further downstream of the step brink, and for higher flowrates they do not occur on the step at all. This means that the 'recovery' observed for the centreline data at the shockwave intersection (e.g. Figure E-4) will be delayed and the underestimate of the aeration efficiency will be worsened.

Conversely, the relative impact of the sidewall standing-wave on the average flow properties should be reduced in a wider channel. In Section 4.4.3, it is found that the size and thickness of the sidewall standing-wave is independent of the channel width, and hence the centreline profile should be more representative of the cross-sectional average on a wide flume. In addition, the sidewall standing-waves are not as prominent with the reduced step height used by EASTMAN and VAN SCHAGEN (2000).

It is difficult to accurately estimate the cross-sectional average properties based upon centreline data in the absence of direct comparison between centreline and cross-sectional average data on the multi-step cascade. On the upper steps, the larger channel width induces a decrease in the influence that the three-dimensional effects have on the cross-sectional average properties. The sidewall standing-wave on lower steps is not as dominant, and the location of the shockwave is more chaotic. This suggests that the centreline profiles should offer a more reasonable estimate of the cross-sectional average properties.

Nevertheless, the data of CONDON and ROWLANDS (1998) and EASTMAN and VAN SCHAGEN (2000) are definitely affected by the reduced detection capacity of the single-tip conductivity probe (Section E.2). Considering the difference in bubble frequency detected by the double-tip and single-tip conductivity probes shown in Figure E-1, the true bubble frequencies on the multi-step cascade could be nearly twice those detected by the single-tip probe. From Equation (E-2), the specific interface area over which mass transfer occurs is directly proportional to the bubble frequency.

The calculated aeration efficiency for oxygen of the step downstream of the first drop from Experiment DT3 (using a double-tip probe and cross-sectional average data) is approximately twice that calculated by CONDON and ROWLANDS (1998) (using a single-tip probe and centreline data only) for similar flow conditions. Considering the effect of using centreline data only, and the significant reduction in bubble detection capability of the single-tip probe, it is quite possible that the single-tip/centreline data underestimate the true aeration efficiency of each step by up to 50%.

APPENDIX F – CENTRELINE POINTER-GAUGE DATA

Pointer-gauge measurements were conducted along the centreline of the multi-step model (Table F-1) for the flow conditions listed in Table F-2. The pointer gauge was used to measure the flow depth on the cascade by visually estimating when the pointer tip was in the water 50% of the time. Comparisons with conductivity probe measurements suggest that the pointer-gauge measurements give a reasonably accurate approximation of the free-falling nappe and the flow depth at the downstream end of the channel. The flow depth obtained within the spray region downstream of nappe impact is more representative of z_{90} to z_{99}, the flow depth corresponding to 90 to 99% air concentration (Figure F-1).

Table F-1 Experimental channel details

		Multi-step
Channel Properties	– Length, L_{casc}	24.0m
	– Width, W	0.5m
	– Overall slope, α	3.4°
Step Properties	– Number of steps	10
	– Step height, h	0.143m
	– Step length, L	2.40m
Intake Characteristics	– Intake height	0.03m
	– Contraction coefficient	1.0

Table F-2 Experimental flow conditions

Exp.	q_w [m²/s]	d_c [mm]	Model	Data	Page
PG1	0.038	52.8	Multi-step	Table F-3, Figure F-2	F-2
PG2	0.080	86.8	Multi-step	Table F-4, Figure F-3	F-3
PG3	0.130	119.9	Multi-step	Table F-5, Figure F-4	F-4
PG4	0.150	131.9	Multi-step	Table F-6, Figure F-5	F-5
PG5	0.163	139.7	Multi-step	Table F-7, Figure F-6	F-6

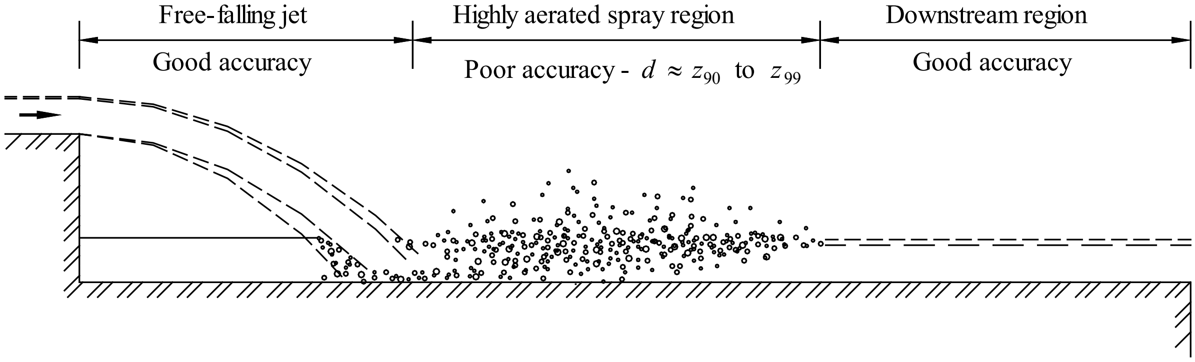

Figure F-1 Flow regions and pointer gauge accuracy

Table F-3 Centreline pointer-gauge data: Experiment PG1

Exp. PG1	Location: Centreline		Flowrate, q_w = 0.038m²/s		Critical Depth, d_c = 52.8mm		
x	*d* [mm]						
[mm]	Step 1	Step 2	Step 4	Step 6	Step 8	Step 9	Step 10
100		93.5	130.5	128.0	127.0	125.5	120.5
200		31.5	68.5	62.5	56.5	56.5	55.0
300		38.5	58.5	53.0	56.0	57.5	60.0
400	29.5	35.5	61.5	58.0	60.0	60.0	60.0
500		32.5	51.0	46.0	49.0	50.5	48.0
600		25.5	34.0	33.5	36.5	39.0	37.0
700		21.0	26.5	25.5	27.5	31.0	27.5
800	28.0	22.0	24.0	23.0	24.5	24.5	22.0
900							
1000		28.0	21.5	25.0	21.0	24.5	24.5
1200	32.5	40.0	35.5	36.5	37.0	37.5	35.0
1400		25.5	32.0	34.0	34.5	38.0	38.0
1600	38.5	26.5	28.0	29.0	28.5	33.0	33.5
1800		29.5	29.0	28.0	25.0	27.0	29.0
2000	31.0	26.5	28.0	28.0	29.0	28.0	23.5
2200		29.0	29.5	29.0	33.5	30.0	
2300		28.5	28.5	27.0	32.5	29.5	
2400	30.0	29.0	26.5	25.5	29.0	28.5	

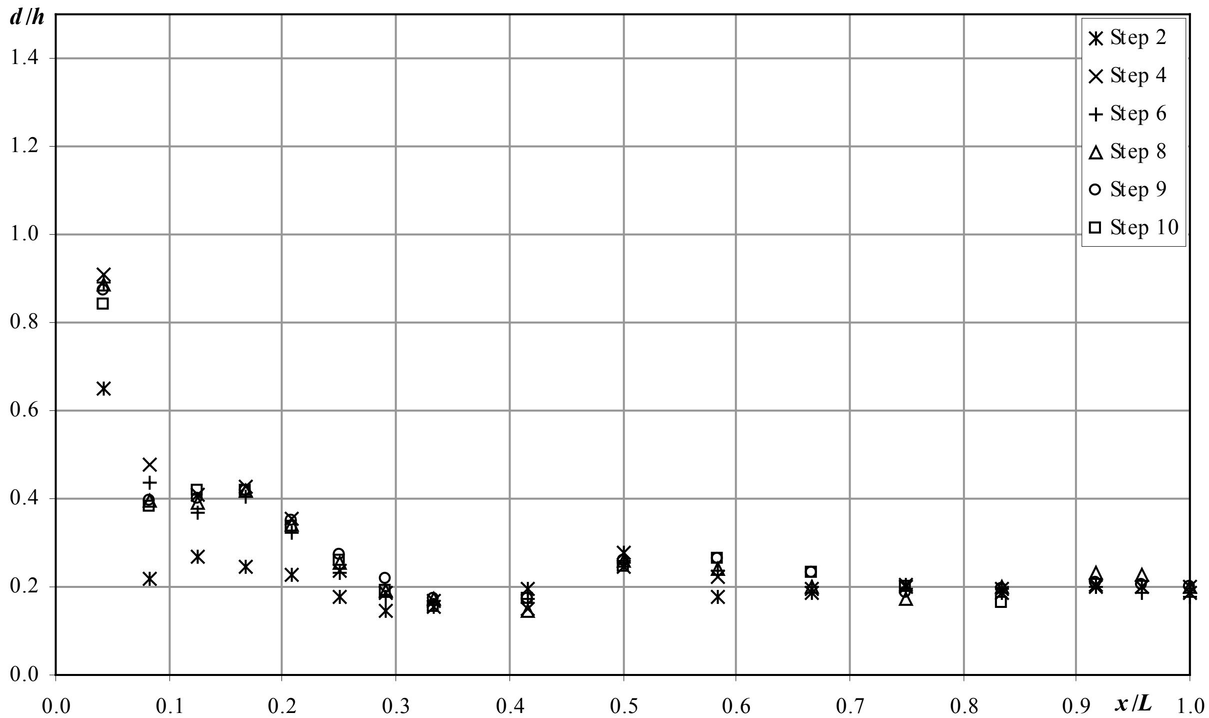

Figure F-2 Centreline pointer-gauge data: Experiment PG1

Table F-4 Centreline pointer-gauge data: Experiment PG2

Exp. PG2	Location: Centreline		Flowrate, q_w = 0.080m²/s		Critical Depth, d_c = 86.8mm		
x	*d* [mm]						
[mm]	Step 1	Step 2	Step 4	Step 6	Step 8	Step 9	Step 10
100		148.0	157.5	156.0	153.0	153.0	154.0
200		122.0	113.5	107.5	113.0	114.0	115.0
300		75.0	62.5	55.5	57.5	65.0	61.0
400	29.0	53.0	56.5	66.0	71.5	75.5	74.0
500		69.0	63.0	82.0	78.5	82.0	83.0
600		85.0	65.0	71.0	69.0	68.0	69.0
700		66.0	50.0	54.0	55.0	55.0	62.5
800	30.0	49.0	51.5	44.0	50.0	50.5	52.0
900		44.0	50.5				
1000		45.0	48.0	37.0	44.5	40.5	46.0
1200	32.0	42.0	48.0	49.5	46.5	51.0	54.0
1400		38.5	48.0	57.0	51.0	50.0	57.0
1600	30.0	42.5	49.5	50.0	52.5	49.5	49.0
1800		52.0	42.5	46.0	47.5	46.0	46.0
2000	28.0	44.5	43.5	43.0	45.5	44.0	42.5
2200		40.5	45.5	43.5	44.5	45.5	
2300		38.5	44.0	44.0	48.0	45.5	
2400	33.0	39.5	43.0	43.5	44.0	43.0	

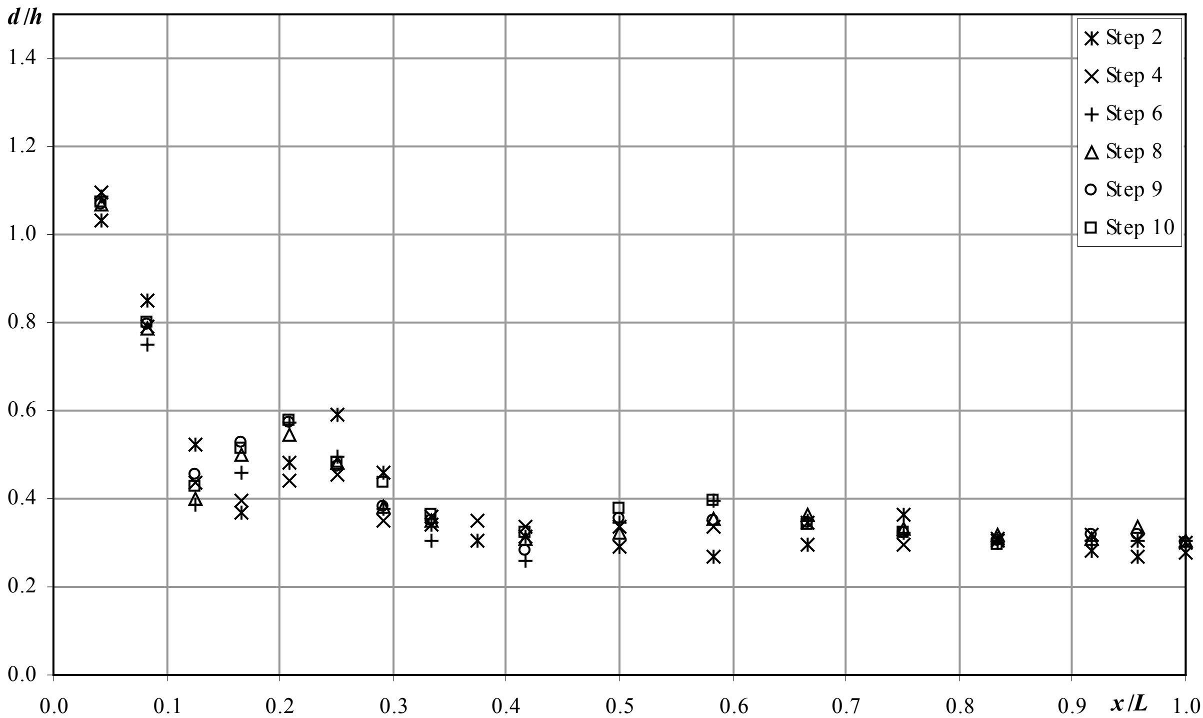

Figure F-3 Centreline pointer-gauge data: Experiment PG2

Table F-5 Centreline pointer-gauge data: Experiment PG3

Exp PG3	Location: Centreline		Flowrate, q_w = 0.130m²/s		Critical Depth, d_c = 119.9mm		
x	d [mm]						
[mm]	Step 1	Step 2	Step 4	Step 6	Step 8	Step 9	Step 10
100		155.5	184.0	168.5	162.0	159.0	154.0
200		149.0	178.5	146.0	130.5	124.0	114.5
300		128.0	159.0	107.0	87.0	78.5	70.0
400	29.0	109.5	134.0	72.0	75.0	80.5	73.0
500		89.0	95.5	79.5	87.0	82.5	90.5
600		56.5	71.0	87.0	87.0	85.5	90.5
700		50.0	81.0	83.0	80.5	79.5	77.5
800	32.5	73.5	91.0	75.0	71.0	64.5	63.0
900		84.0	89.0				
1000		85.5	64.0	60.5	56.5	60.0	57.5
1200	32.0	79.5	39.5	60.0	56.5	59.5	57.5
1400		53.0	33.5	66.0	59.0	60.0	57.0
1600	34.0	46.5	39.0	67.5	66.0	58.5	52.5
1800		41.5	55.0	63.0	63.5	55.5	55.0
2000	35.5	34.5	68.5	57.5	58.0	52.5	48.5
2200		37.0	82.0	55.0	54.5	53.0	
2300		41.0	78.5	52.0	54.0	52.0	
2400	33.5	46.0	76.5	47.0	52.5	51.5	

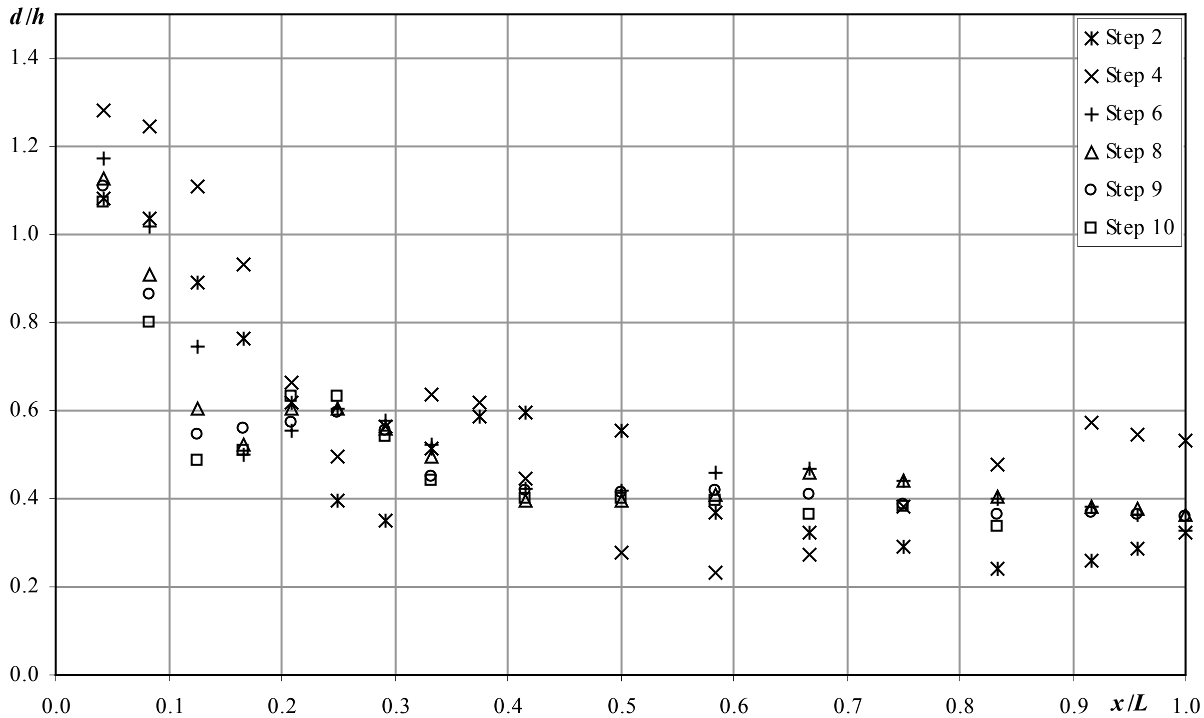

Figure F-4 Centreline pointer-gauge data: Experiment PG3

Table F-6 Centreline pointer-gauge data: Experiment PG4

Exp. PG4	Location: Centreline		Flowrate, q_w = 0.150m²/s		Critical Depth, d_c = 131.9mm		
x	*d* [mm]						
[mm]	Step 1	Step 2	Step 4	Step 6	Step 8	Step 9	Step 10
100		166.0	188.0	194.5	166.5	163.5	158.5
200		158.5	172.5	178.5	132.0	129.5	126.0
300		152.5	155.0	150.0	97.0	96.5	88.5
400	30.0	138.0	126.5	125.5	75.5	73.5	71.5
500		120.5	95.5	86.5	86.5	83.0	84.0
600		97.5	69.5	78.5	98.0	100.0	91.0
700		80.0	91.5	90.5	95.5	95.0	93.0
800	29.0	55.0	108.0	90.0	81.0	83.5	89.5
900		66.5	113.5				
1000		86.0	101.5	62.5	64.5	61.5	67.0
1200	29.0	94.5	87.0	43.5	62.5	57.0	62.5
1400		95.0	59.5	48.0	62.0	61.0	62.5
1600	35.5	71.0	53.0	89.0	63.5	65.0	61.0
1800		53.5	59.0	96.5	60.5	61.0	61.0
2000	38.0	52.5	64.0	82.0	59.5	60.0	56.5
2200		42.5	72.0	73.5	58.5	56.5	
2300		45.0	72.0	70.0	55.5	55.0	
2400	38.0	42.4	69.5	61.5	52.5	53.5	

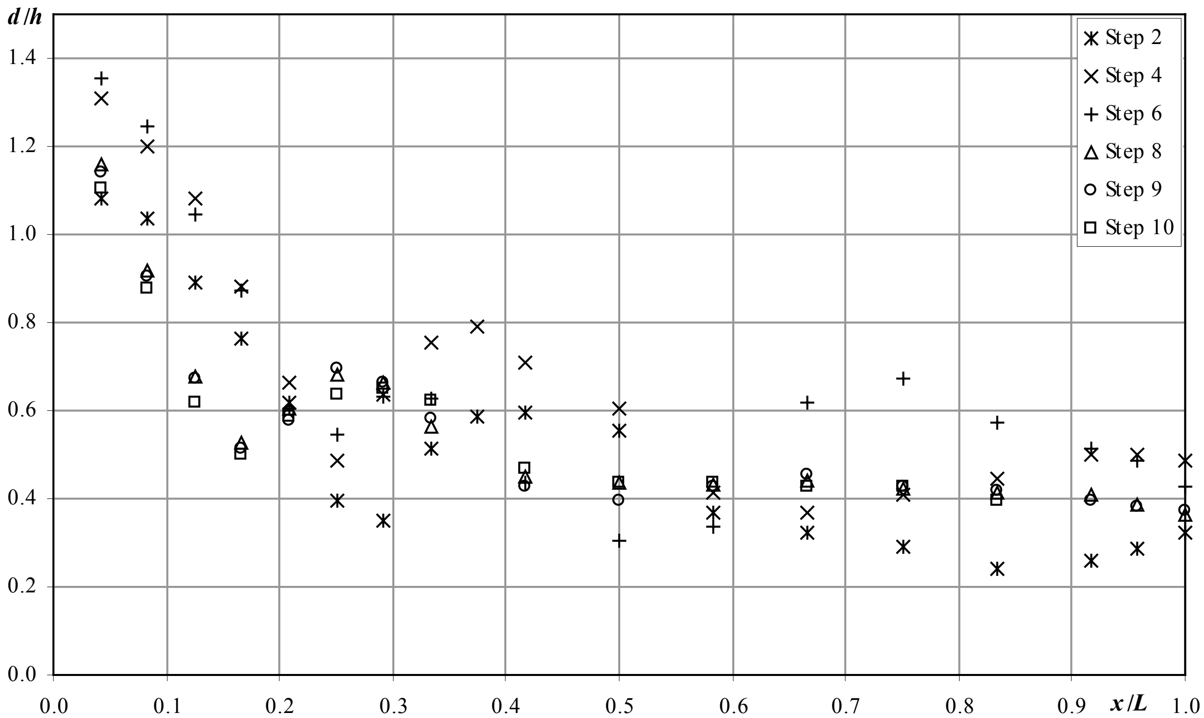

Figure F-5 Centreline pointer-gauge data: Experiment PG4

Table F-7 Centreline pointer-gauge data: Experiment PG5

Exp. PG5	Location: Centreline		Flowrate, $q_w = 0.163 m^2/s$		Critical Depth, $d_c = 139.7mm$		
x	*d* [mm]						
[mm]	Step 1	Step 2	Step 4	Step 6	Step 8	Step 9	Step 10
100		166.0	194.5	210.0	175.5	172.0	167.0
200		164.0	186.0	191.0	147.0	142.0	138.5
300		156.5	181.0	181.0	113.0	108.0	106.0
400	30.0	145.5	162.0	148.5	84.5	84.0	81.5
500		130.0	140.5	119.0	102.0	103.0	97.0
600		114.5	114.5	106.5	104.0	106.5	110.0
700		100.0	85.0	97.0	113.5	115.0	127.5
800	29.5	73.0	104.5	108.5	103.0	105.0	111.0
900		60.5	104.0				
1000		73.5	133.0	76.5	75.0	75.0	80.5
1200	28.0	107.0	122.0	44.5	73.0	72.5	73.5
1400		100.0	69.0	45.5	81.0	69.0	74.0
1600	33.0	92.5	57.5	59.5	77.0	69.0	76.0
1800		60.0	56.0	97.5	72.5	77.0	71.0
2000	37.0	59.5	67.0	112.0	65.0	65.5	68.0
2200		57.5	76.0	98.0	64.0	62.5	
2300		53.0	79.0	88.0	62.5	62.0	
2400	38.0	52.5	78.5	81.5	60.0	59.0	

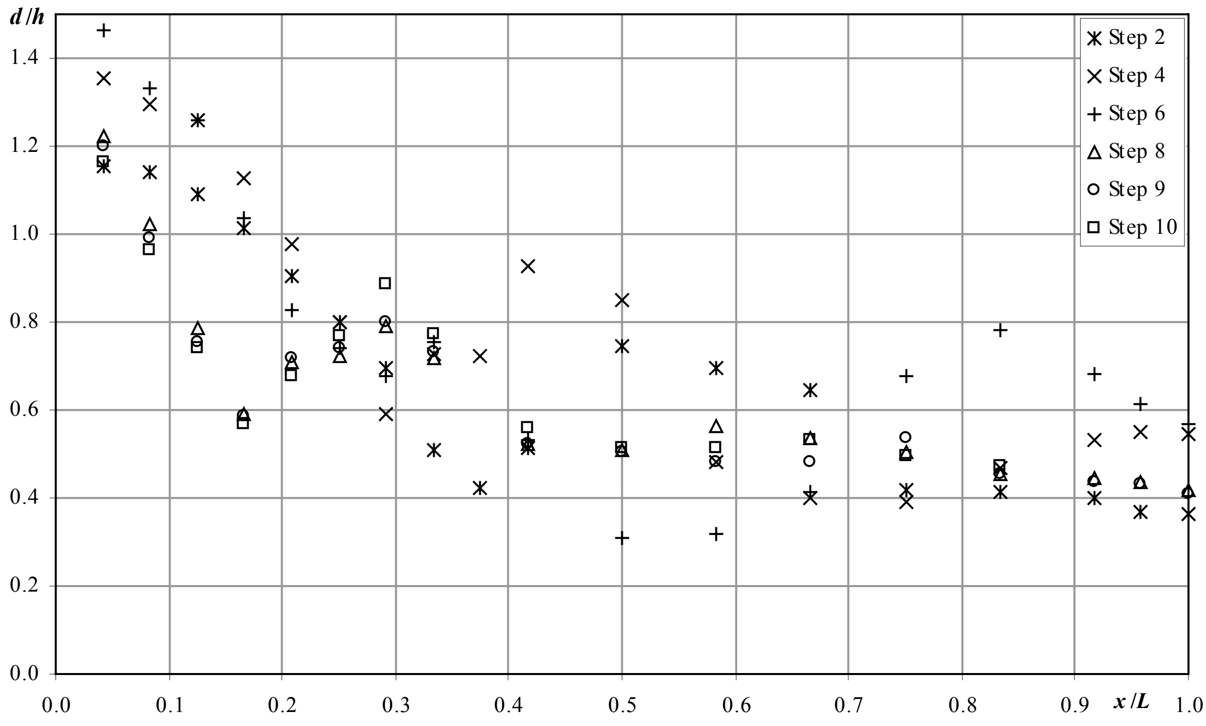

Figure F-6 Centreline pointer-gauge data: Experiment PG5

APPENDIX G – THREE-DIMENSIONAL FLOW PATTERN DATA

The nappe flow on the cascade displays three-dimensional flow patterns downstream of the first drop and on the subsequent steps. The change in flow direction at nappe impact results in the formation of *sidewall standing-waves*, long narrow waves similar to the bow-wave on a ship that form on each sidewall downstream of the nappe impact, and *shockwaves* in the supercritical flow. The three-dimensional flow patterns are described using the following characteristic dimensions, which are illustrated in Figure G-1:

L_D	The horizontal drop length of the free-falling nappe, measured at the centreline. In Experiments 3D1 to 3D9 this is determined visually from above the flow, and L_D is actually the distance to where the upper surface of the nappe intersects the rebounding spray, not the 'true' drop length (where the centre of nappe impacts on the step). In Experiments 3D10 to 3D16, the nappe impact may be observed through the glass wall of the channel.
L_M	The horizontal distance to the peak height of the sidewall standing-wave.
d_M	The peak vertical height of the sidewall standing-wave.
t_M	The width of the sidewall standing-wave at L_M.
$L_{SW\text{-}W}$	The horizontal distance to the (projected) shockwave origin on the sidewall.
$L_{SW\text{-}INT}$	The horizontal distance to the point where the shockwaves intersect. This length may be an actual location on the step, or an extrapolated location beyond the end of the step.
θ	The angle of the shockwave to the flow direction. The shockwave was observed to exhibit a discontinuity in the angle under some conditions. In these circumstances, the angle is described in terms of θ_W and θ_{CL}, the angle of the shockwave near the sidewall and near the centreline respectively.

Characteristics of the flow patterns were measured employing a pointer gauge for measuring depths and a metre-rule and tape measure for horizontal distances. Experiments 3D1 to 3D5 examine the flow patterns on Steps 2, 3, 5, 7 and 8 of a 10-step cascade[a]. Experiments 3D6 to 3D9 were performed on Steps 2 and 3 of the same cascade, however spacers were installed

[a] Step 2 is downstream of the 1st drop, i.e. there is no drop onto Step 1.

on the sidewall upstream of the 1st drop to artificially ventilate (allow air to enter) the cavity beneath the free-falling jet onto Step 2. The nappe onto Step 3 was not artificially ventilated. Experiments 3D10 to 3D15 examine the three-dimensional flow characteristics on a single-step model with identical height but half the width of the multi-step models. Details of the experimental apparatus are given in Table G-1.

Data for experiments 3D1 to 3D5, 3D6 to 3D9 and 3D10 to 3D15 are listed in Table G-2 (Page G-3), Table G-3 (Page G-4), and Table G-4 (Page G-5) respectively.

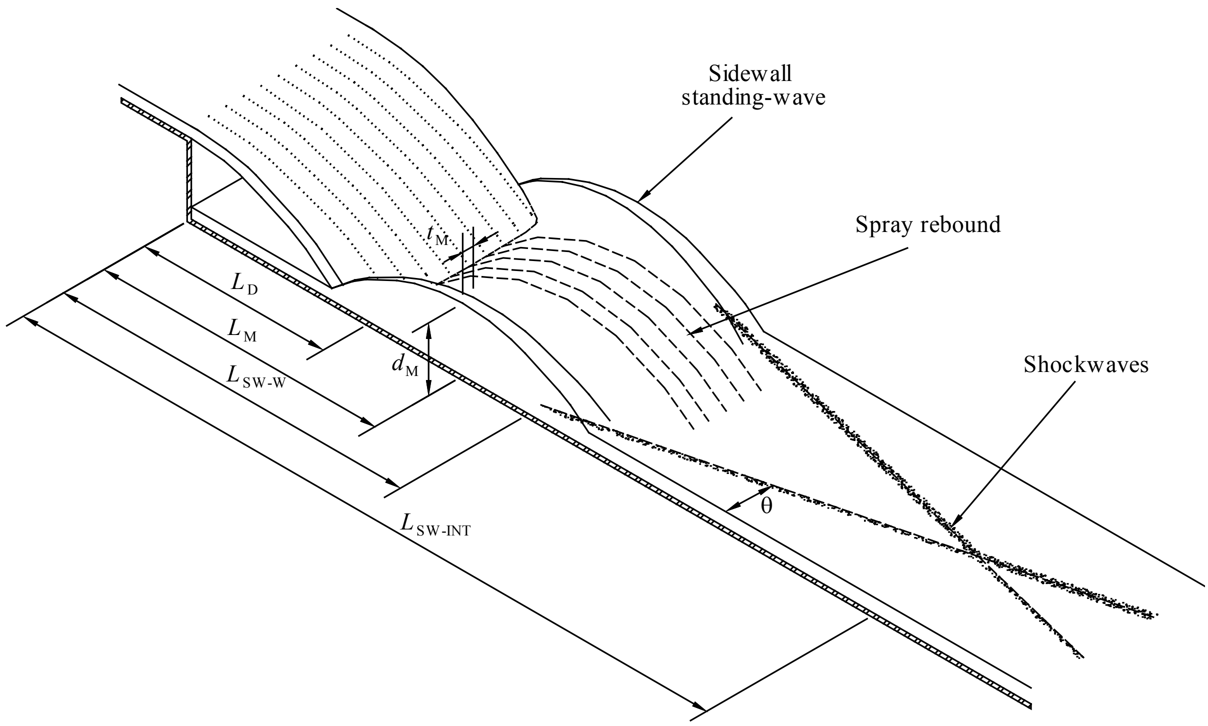

Figure G-1 Characteristic dimension definitions used for the three-dimensional flow patterns

Table G-1 Experimental channel details

			Multi-step (non-ventilated)	Multi-step (ventilated)	Single-step
Channel Properties	–	Length, L_{casc}	24.0m	24.0m	2.4m
	–	Width U/S of first drop	0.5m	0.476m	0.237m
	–	Channel width, W	0.5m	0.5m	0.25m
	–	Overall slope, α	3.4°	3.4°	-
Step Properties	–	Number of steps	10	10	1
	–	Step height, h	0.143m	0.143m	0.143m
	–	Step length, L	2.40m	2.40m	2.40m
Intake Characteristics	–	Intake height	0.03m	0.03m	0.046m
	–	Contraction coefficient	1.0	1.0	0.74

Table G-2 Three-dimensional flow patterns: multi-step model (non-ventilated)

Step 2	Step Height: 143.5mm		Upstream Width: 500mm		Width on Step: 500mm	
Exp.:		3D1	3D2	3D3	3D4	3D5
q_w	[m²/s]	0.038	0.080	0.130	0.150	0.163
d_0	[mm]	31.0	30.0	35.0	38.0	37.0
L_D	[mm]	190	390	630	750	820
L_M	[mm]	270	480	820	920	980
d_M	[mm]	59	90	85	75	72
t_M	[mm]	40	45	35	35	47
$L_{SW\text{-}W}$	[mm]	140	430	950	1200	1400
$L_{SW\text{-}INT}$	[mm]	1170	1660	2490	3250	3300
θ_{CL}	[rad]	0.238	0.201	0.131	0.094	0.101
θ_{SW}	[rad]	-	-	0.253	0.250	0.262

Step 3	Step Height: 143.5mm		Upstream Width: 500mm		Width on Step: 500mm	
Exp.:		3D1	3D2	3D3	3D4	3D5
q_w	[m²/s]	0.038	0.080	0.130	0.150	0.163
d_0	[mm]	29.0	39.5	46.0	42.4	52.5
L_D	[mm]	240	380	610	750	770
L_M	[mm]	300	470	770	880	960
d_M	[mm]	60	91	110	120	120
t_M	[mm]	45	48	42	48	42
$L_{SW\text{-}W}$	[mm]	220	390	700	930	1100
$L_{SW\text{-}INT}$	[mm]	1250	1490	1980	2400	2620
θ_{CL}	[rad]	0.238	0.223	0.193	0.138	0.127
θ_{SW}	[rad]	-	-	-	0.215	0.215

Step 5	Step Height: 143.5mm		Upstream Width: 500mm		Width on Step: 500mm	
Exp.:		3D1	3D2	3D3	3D4	3D5
q_w	[m²/s]	0.038	0.080	0.130	0.150	0.163
d_0	[mm]	26.5	43.0	76.5	69.5	78.5
L_D	[mm]	240	340	520	570	570
L_M	[mm]	320	420	660	660	720
d_M	[mm]	57	88	114	118	111
t_M	[mm]	48	53	50	55	47
$L_{SW\text{-}W}$	[mm]	190	320	500	710	720
$L_{SW\text{-}INT}$	[mm]	1200	1350	1600	2000	1920
θ	[rad]	0.243	0.238	0.223	0.191	0.205

Step 7	Step Height: 143.5mm		Upstream Width: 500mm		Width on Step: 500mm
Exp.:		3D1	3D2	3D3	3D4	3D5
q_w	[m²/s]	0.038	0.080	0.130	0.150	0.163
d_0	[mm]	25.5	43.5	47.0	61.5	81.5
L_D	[mm]	240	330	-	450	480
L_M	[mm]	330	420	-	550	610
d_M	[mm]	58	91	-	119	124
t_M	[mm]	48	50	-	65	65
L_{SW-W}	[mm]	230	450	-	480	490
L_{SW-INT}	[mm]	1230	1380	-	1480	1570
θ	[rad]	0.245	0.263	-	0.245	0.227

Step 8	Step Height: 143.5mm		Upstream Width: 500mm		Width on Step: 500mm
Exp.:		3D1	3D2	3D3	3D4	3D5
q_w	[m²/s]	0.038	0.080	0.130	0.150	0.163
d_0	[mm]	29.0	44.0	52.5	52.5	60.0
L_D	[mm]	-	330	-	-	-
L_M	[mm]	-	420	-	-	-
d_M	[mm]	-	91	-	-	-
t_M	[mm]	-	51	-	-	-
L_{SW-W}	[mm]	-	440	-	-	-
L_{SW-INT}	[mm]	-	1370	-	-	-
θ	[rad]	-	0.263	-	-	-

Table G-3 Three-dimensional flow patterns: multi-step model (ventilated)

Step 2	Step Height: 143.5mm	Upstream Width: 476mm		Width on Step: 500mm
Exp.:		3D6	3D7	3D8	3D9
q_w	[m²/s]	0.039	0.057	0.088	0.122
d_0	[mm]	36.6	35.1	34.2	34.3
L_D	[mm]	170	270	380	500
L_M	[mm]	270	430	580	830
d_M	[mm]	50	70	83	88
t_M	[mm]	-	-	-	-
L_{SW-W}	[mm]	135	210	380	640
L_{SW-INT}	[mm]	1165	1295	1685	2335
θ	[rad]	0.238	0.226	0.189	0.146

Step 3	Step Height: 143.5mm	Upstream Width: 500mm		Width on Step: 500mm
Exp.:	3D6	3D7	3D8	3D9
q_w [m²/s]	0.039	0.057	0.088	0.122
d_0 [mm]	-	-	-	-
L_D [mm]	170	230	330	460
L_M [mm]	280	380	470	600
d_M [mm]	50	65	78	75
t_M [mm]	-	-	-	-
$L_{SW\text{-}W}$ [mm]	120	190	310	360
$L_{SW\text{-}INT}$ [mm]	1165	1315	1465	2045
θ [rad]	0.235	0.219	0.213	0.147

Table G-4 Three-dimensional flow patterns: single-step model (ventilated)

Step 2	Step Height: 143.5mm		Upstream Width: 237mm		Width on Step: 250mm	
Exp.:	3D11	3D12	3D13	3D14	3D15	3D16
q_w [m²/s]	0.038	0.050	0.069	0.087	0.104	0.123
d_0 [mm]	34.0	34.0	34.0	34.3	34.5	34.5
L_D [mm]	220	265	365	440	550	650
L_M [mm]	315	430	550	650	770	890
d_M [mm]	50	55	68	80	80	95
t_M [mm]	-	-	-	-	-	-
$L_{SW\text{-}W}$ [mm]	180	270	400	520	630	750
$L_{SW\text{-}INT}$ [mm]	730	830	1000	1190	1350	1520
θ [rad]	0.223	0.220	0.205	0.184	0.172	0.161

APPENDIX H – SINGLE-TIP CONDUCTIVITY PROBE DATA

H.1 DESCRIPTION

Air-concentration distributions were obtained on the multi-step cascade (Table H-1) for the flow conditions and locations listed in Table H-2. Air concentration was measured using a single-tip conductivity probe, shown in Figure H-1. For experiments ST1 to ST3 (Table H-3 to Table H-5), the sample was divided into discrete 5s segments. The column 'Mean' in Table H-3 to Table H-5 describes the time-average air concentration over the 180s sample time, while the columns 'Min' and 'Max' describe the minimum and maximum time-average air concentration of a 5s segment during the 180s sample time respectively. For experiments ST4 and ST5 (Table H-6 and Table H-7), the air concentration was continuously output from the probe as the mean air concentration over the previous 30 seconds. 'Mean' is the average air concentration over the 180s sample time, however 'Min' and 'Max' are the minimum and maximum 30s average observed over the sample time.

Table H-1 Experimental channel details

		Multi-step
Channel Properties	– Length, L_{casc}	24.0m
	– Channel width, W	0.5m
	– Overall slope, α	3.4°
Step Properties	– Number of steps	10
	– Step height, h	0.143m
	– Step length, L	2.40m
Intake Characteristics	– Intake height	0.03m
	– Contraction coefficient	1.0

Table H-2 Experimental flow conditions

Exp.	q_w [m²/s]	Step No.	Transverse Distance, Y	Data	Page
ST1	0.150	2	0	Table H-3 Figure H-2	H-2 H-44
ST2	0.150	2	0.7	Table H-4 Figure H-3	H-12 H-45
ST3	0.150	2	0.99	Table H-5 Figure H-4	H-20 H-46
ST4	0.150	9	0	Table H-6 Figure H-5	H-28 H-47
ST5	0.130	9	0	Table H-7 Figure H-6	H-36 H-48

Notes: Y = Distance from centreline / (Channel width / 2) = $2y/W$, i.e. $Y = 0$ is centreline, $Y = 1$ is channel wall.

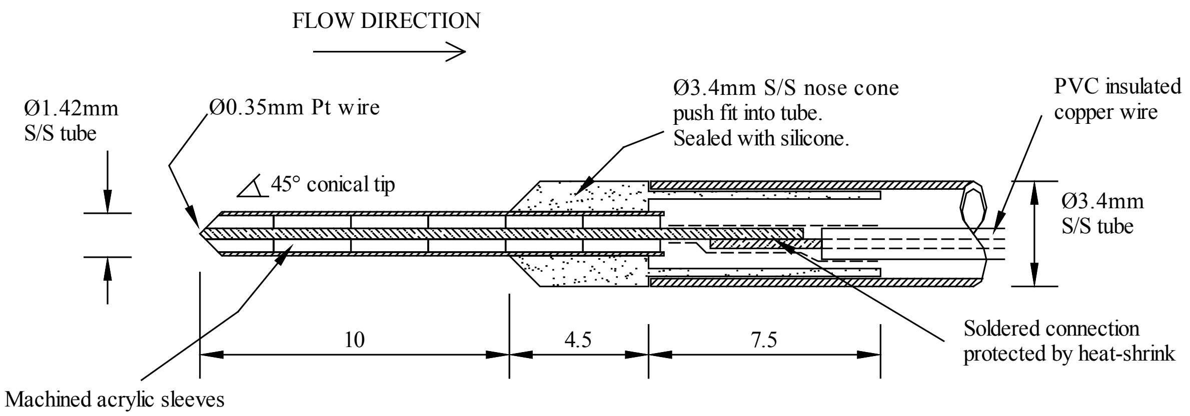

Figure H-1 Section through the single-tip conductivity probe tip

H.2 EXPERIMENTAL DATA

Table H-3 Single-tip conductivity probe data: Experiment ST1 (Step 2, q_w = 0.150m²/s, Y = 0)

Step 2 q_w = 0.150m²/s		x = 0mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
0.75	0.000	0.000	0.000
25.75	0.000	0.000	0.001
27.75	0.000	0.002	0.003
28.75	0.001	0.004	0.008
30.75	0.013	0.019	0.033
31.75	0.028	0.040	0.058
32.75	0.061	0.078	0.103
33.75	0.110	0.142	0.182
34.75	0.208	0.235	0.274
35.75	0.334	0.368	0.407
36.75	0.472	0.505	0.493
37.75	0.606	0.633	0.696
38.75	0.725	0.751	0.795
39.75	0.823	0.857	1.000
40.75	0.877	0.912	0.934
41.75	0.922	0.950	1.000
42.75	0.960	0.974	0.984
44.75	0.986	0.993	1.000
46.75	0.995	0.998	1.000
48.75	0.997	1.000	1.000

Step 2 q_w = 0.150m²/s		x = 20mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
3.45	0.000	0.000	0.001
3.70	0.000	0.001	0.008
3.95	0.000	0.011	0.056
4.10	0.021	0.070	0.134
4.20	0.048	0.194	0.425
4.35	0.105	0.429	0.690
4.45	0.251	0.581	0.799
4.55	0.450	0.834	0.957
4.70	0.843	0.976	0.999
4.81	0.958	0.992	1.000
4.95	0.997	1.000	1.000
123.70	1.000	1.000	1.000
125.70	0.999	1.000	1.000
126.45	0.988	0.992	0.994
126.70	0.958	0.966	1.000
126.95	0.918	0.930	0.943
127.20	0.821	0.862	0.893
127.45	0.529	0.558	0.599
127.70	0.340	0.368	0.388
127.95	0.223	0.245	0.270
128.20	0.092	0.118	0.144
128.45	0.026	0.031	0.036
128.70	0.009	0.013	0.013
129.20	0.005	0.007	0.010

129.70	0.000	0.001	0.002
130.70	0.000	0.000	0.001
133.70	0.000	0.000	0.000
151.70	0.000	0.000	0.000
153.70	0.000	0.001	0.002
155.70	0.000	0.002	0.004
157.70	0.004	0.009	0.015
159.70	0.024	0.035	0.048
160.70	0.044	0.067	0.098
161.70	0.115	0.137	0.165
162.70	0.181	0.215	0.257
163.70	0.303	0.328	0.355
164.70	0.433	0.465	0.485
165.70	0.572	0.601	0.631
166.70	0.687	0.724	0.752
167.70	0.798	0.825	0.855
168.70	0.868	0.895	0.927
169.70	0.896	0.937	0.961
171.70	0.962	0.981	0.991
173.70	0.992	0.996	0.999
175.70	0.996	0.999	1.000
177.70	0.997	1.000	1.000
179.70	0.999	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 100$mm, $y = 0$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.002
2.70	0.000	0.000	0.004
3.70	0.000	0.000	0.001
4.20	0.003	0.004	0.017
4.45	0.033	0.098	0.173
4.70	0.247	0.444	0.709
4.95	0.650	0.894	0.973
5.20	0.949	0.991	1.000
5.70	0.994	1.000	1.000
6.70	1.000	1.000	1.000
111.70	1.000	1.000	1.000
113.70	0.998	0.999	1.000
115.70	0.993	0.996	1.000
118.70	0.935	0.949	0.967
119.70	0.886	0.905	0.920
121.70	0.732	0.770	0.810
122.70	0.539	0.603	0.648
123.70	0.383	0.434	0.486
124.70	0.345	0.396	0.437
126.70	0.168	0.196	0.224
128.70	0.058	0.076	0.088
130.70	0.000	0.034	0.044
133.70	0.004	0.007	0.011
136.70	0.000	0.001	0.001
139.70	0.000	0.000	0.001
141.70	0.000	0.000	0.001
145.70	0.000	0.002	0.003
148.70	0.000	0.004	0.009
151.70	0.006	0.014	0.031
154.70	0.038	0.061	0.083
156.70	0.114	0.145	0.172
157.70	0.200	0.223	0.239
158.70	0.288	0.320	0.348
159.70	0.397	0.427	0.458
160.70	0.505	0.534	0.554
161.70	0.613	0.643	0.682
162.70	0.689	0.746	0.774
163.70	0.788	0.815	0.859
164.70	0.855	0.885	0.905
165.70	0.894	0.924	0.941
167.70	0.944	0.969	0.984
169.70	0.981	0.990	0.997
171.70	0.990	0.997	1.000
173.70	0.996	0.999	1.000
176.70	0.998	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 200$mm, $y = 0$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
4.20	0.000	0.000	0.000
4.35	0.000	0.001	0.004
4.45	0.000	0.004	0.013
4.70	0.001	0.013	0.026
4.95	0.096	0.152	0.202
5.20	0.292	0.427	0.550
5.45	0.709	0.796	0.863
5.70	0.965	0.992	1.000
5.95	0.996	1.000	1.000
6.20	1.000	1.000	1.000
91.70	1.000	1.000	1.000

95.70	0.999	1.000	1.000
97.70	0.997	0.999	1.000
101.70	0.987	0.993	0.996
105.20	0.951	0.961	0.972
106.70	0.912	0.932	0.956
108.70	0.819	0.846	0.878
110.70	0.691	0.737	0.784
112.70	0.576	0.618	0.659
114.70	0.455	0.508	0.558
116.70	0.317	0.365	0.425
118.70	0.269	0.295	0.337
120.70	0.212	0.236	0.262
123.70	0.116	0.133	0.147
126.70	0.061	0.073	0.085
131.70	0.014	0.020	0.028
136.70	0.007	0.012	0.021
138.70	0.000	0.014	0.028
141.70	0.016	0.030	0.049
143.70	0.039	0.065	0.092
145.70	0.085	0.110	0.148
147.70	0.164	0.205	0.254
149.70	0.326	0.353	0.389
151.70	0.487	0.520	0.544
153.70	0.654	0.693	0.712
155.70	0.788	0.816	0.838
157.70	0.888	0.908	0.927
159.70	0.931	0.956	0.975
161.70	0.964	0.981	0.990
163.70	0.984	0.992	0.997
166.70	0.994	0.997	1.000
169.70	0.997	0.999	1.000
173.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		$x = 300mm$, $y = 0mm$	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
4.70	0.000	0.000	0.000
5.20	0.000	0.003	0.004
5.45	0.000	0.009	0.020
5.70	0.000	0.024	0.086
5.95	0.000	0.097	0.294
6.20	0.058	0.244	0.449
6.45	0.000	0.522	0.713
6.70	0.464	0.846	0.972
6.95	0.728	0.944	1.000
7.20	0.997	1.000	1.000
61.70	1.000	1.000	1.000
71.70	0.999	1.000	1.000
76.70	0.998	0.999	1.000
81.70	0.992	0.995	0.998
86.70	0.966	0.975	0.988
89.70	0.923	0.945	0.962
91.70	0.869	0.900	0.927
94.70	0.774	0.819	0.853
97.70	0.647	0.716	0.771
100.70	0.542	0.591	0.640
103.70	0.441	0.470	0.507
106.70	0.329	0.366	0.395
109.70	0.262	0.284	0.304
113.70	0.162	0.188	0.212
117.70	0.095	0.112	0.128
121.70	0.051	0.071	0.093
125.70	0.046	0.062	0.081
129.70	0.085	0.114	0.154
133.70	0.177	0.233	0.307
135.20	0.266	0.308	0.342
136.70	0.352	0.393	0.438
138.70	0.489	0.521	0.553
140.20	0.561	0.614	0.653
141.70	0.677	0.708	0.737
143.20	0.756	0.790	0.831
144.70	0.800	0.850	0.880
146.20	0.869	0.892	0.922
147.70	0.914	0.933	0.952
149.70	0.936	0.961	0.973
152.70	0.974	0.985	0.993
156.70	0.988	0.996	0.999
161.70	0.997	0.999	1.000
166.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		$x = 400mm$, $y = 0mm$	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
4.20	0.000	0.000	0.000
4.70	0.000	0.001	0.010
5.20	0.002	0.009	0.028

5.70	0.016	0.039	0.074
5.95	0.050	0.085	0.148
6.20	0.144	0.210	0.264
6.45	0.253	0.304	0.358
6.70	0.370	0.432	0.506
6.95	0.491	0.619	0.688
7.20	0.698	0.763	0.829
7.45	0.795	0.851	0.906
7.70	0.892	0.939	0.968
8.20	0.957	0.985	1.000
8.70	0.995	0.999	1.000
9.70	1.000	1.000	1.000
41.70	1.000	1.000	1.000
51.70	0.998	0.999	1.000
61.70	0.985	0.991	0.995
66.70	0.947	0.964	0.978
71.70	0.857	0.894	0.910
76.70	0.709	0.773	0.811
81.70	0.612	0.651	0.692
85.70	0.512	0.553	0.590
89.70	0.384	0.426	0.455
93.70	0.312	0.346	0.383
97.70	0.227	0.255	0.290
101.70	0.161	0.194	0.237
105.70	0.133	0.159	0.187
109.70	0.120	0.158	0.202
113.70	0.149	0.207	0.262
116.70	0.217	0.280	0.322
119.70	0.337	0.389	0.446
121.70	0.436	0.477	0.514
123.70	0.538	0.568	0.602
125.70	0.625	0.660	0.712
127.70	0.730	0.745	0.761
129.70	0.802	0.818	0.839
131.70	0.860	0.880	0.899
133.70	0.893	0.915	0.941
135.70	0.920	0.943	0.961
138.70	0.964	0.973	0.984
142.70	0.976	0.989	0.996
146.70	0.993	0.997	0.999
151.70	0.997	0.999	1.000
157.70	0.999	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 500$mm, $y = 0$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.010	0.035
2.70	0.000	0.010	0.027
3.70	0.003	0.032	0.064
4.30	0.016	0.052	0.114
4.70	0.049	0.114	0.177
5.20	0.140	0.221	0.324
5.70	0.255	0.332	0.419
6.20	0.359	0.447	0.504
6.70	0.552	0.604	0.661
7.20	0.645	0.715	0.765
7.70	0.730	0.810	0.893
8.20	0.785	0.847	0.888
8.70	0.840	0.904	0.954
9.70	0.949	0.971	0.990
11.70	0.985	0.996	1.000
16.70	0.993	0.999	1.000
26.70	0.995	0.998	0.999
31.70	0.982	0.993	0.997
41.70	0.946	0.961	0.982
46.70	0.891	0.921	0.957
51.70	0.810	0.850	0.899
56.70	0.667	0.752	0.794
61.70	0.588	0.634	0.701
66.70	0.484	0.513	0.550
71.70	0.380	0.415	0.454
76.70	0.308	0.334	0.364
81.70	0.247	0.283	0.319
86.70	0.218	0.259	0.354
91.70	0.216	0.303	0.379
96.70	0.340	0.386	0.443
99.70	0.400	0.464	0.518
101.70	0.505	0.545	0.589
103.70	0.563	0.603	0.633
105.70	0.649	0.677	0.699
107.70	0.705	0.738	0.764
109.70	0.774	0.793	0.815
111.70	0.823	0.844	0.858
113.70	0.857	0.890	0.906
115.70	0.899	0.920	0.941
118.70	0.941	0.953	0.969
121.70	0.964	0.976	0.986
125.70	0.980	0.989	0.993

131.70	0.994	0.997	0.999
139.70	0.999	1.000	1.000
147.70	1.000	1.000	1.000

Step 2 $q_w = 0.150m^2/s$	$x = 600mm, y = 0mm$		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.174	0.350	0.491
2.70	0.244	0.383	0.503
3.70	0.343	0.500	0.645
4.70	0.489	0.619	0.728
5.70	0.511	0.654	0.743
6.70	0.589	0.718	0.842
7.70	0.702	0.798	0.888
8.70	0.723	0.805	0.884
9.70	0.801	0.847	0.899
10.70	0.771	0.881	0.927
11.70	0.817	0.884	0.948
12.70	0.864	0.905	0.945
13.70	0.874	0.914	0.945
15.70	0.893	0.923	0.958
17.70	0.903	0.926	0.949
19.70	0.885	0.918	0.947
21.70	0.868	0.906	0.932
23.70	0.844	0.892	0.933
26.70	0.796	0.857	0.904
31.70	0.712	0.785	0.818
35.70	0.634	0.704	0.764
39.70	0.562	0.627	0.688
43.70	0.527	0.565	0.600
47.70	0.464	0.498	0.536
51.70	0.427	0.454	0.481
55.70	0.372	0.415	0.453
59.70	0.353	0.387	0.422
63.70	0.326	0.380	0.431
66.70	0.317	0.385	0.458
69.70	0.365	0.419	0.489
72.70	0.397	0.458	0.503
75.70	0.451	0.506	0.548
78.70	0.510	0.564	0.630
81.70	0.607	0.640	0.685
84.70	0.685	0.716	0.752
87.70	0.753	0.787	0.818
90.70	0.816	0.837	0.865
93.70	0.850	0.885	0.915
96.70	0.912	0.928	0.942
99.70	0.946	0.957	0.966
103.70	0.968	0.979	0.987
107.70	0.982	0.989	0.995
113.70	0.992	0.997	0.999
119.70	0.998	0.999	1.000
127.70	0.999	1.000	1.000
135.70	1.000	1.000	1.000

Step 2 $q_w = 0.150m^2/s$	$x = 700mm, y = 0mm$		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.056	0.085	0.111
2.70	0.075	0.109	0.128
3.70	0.126	0.153	0.175
4.70	0.158	0.186	0.230
5.70	0.161	0.199	0.247
6.70	0.178	0.222	0.261
7.70	0.180	0.228	0.264
9.70	0.209	0.246	0.276
11.70	0.242	0.274	0.312
13.70	0.256	0.298	0.332
16.70	0.306	0.339	0.396
19.70	0.342	0.367	0.397
23.70	0.365	0.401	0.443
27.70	0.378	0.427	0.478
31.70	0.386	0.429	0.498
35.70	0.389	0.445	0.530
39.70	0.399	0.456	0.513
43.70	0.404	0.493	0.588
45.70	0.475	0.524	0.594
47.70	0.504	0.558	0.601
49.70	0.536	0.589	0.665
51.70	0.574	0.619	0.694
53.70	0.615	0.651	0.691
55.70	0.654	0.691	0.730
57.70	0.694	0.732	0.759
59.70	0.715	0.764	0.790
61.70	0.770	0.796	0.822
63.70	0.789	0.824	0.862
65.70	0.841	0.861	0.885
67.70	0.873	0.888	0.905
69.70	0.897	0.909	0.921

71.70	0.912	0.929	0.948
74.70	0.938	0.949	0.961
77.70	0.958	0.967	0.978
81.70	0.975	0.984	0.989
85.70	0.985	0.991	0.996
91.70	0.994	0.997	0.999
97.70	0.997	0.999	1.000
103.70	0.998	1.000	1.000
109.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		x = 800mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.004	0.007	0.009
3.70	0.010	0.013	0.018
5.70	0.020	0.025	0.031
7.70	0.027	0.034	0.041
9.70	0.033	0.041	0.053
11.70	0.041	0.047	0.056
14.70	0.044	0.051	0.063
17.70	0.048	0.055	0.067
19.70	0.053	0.062	0.076
21.70	0.061	0.072	0.095
23.70	0.079	0.089	0.106
25.70	0.094	0.115	0.137
26.70	0.109	0.137	0.173
27.70	0.144	0.173	0.196
28.70	0.158	0.205	0.238
29.70	0.205	0.245	0.284
30.70	0.244	0.283	0.323
31.70	0.282	0.330	0.397
32.70	0.329	0.390	0.442
33.70	0.385	0.438	0.501
34.70	0.461	0.498	0.555
35.70	0.488	0.552	0.596
36.70	0.554	0.598	0.635
37.70	0.620	0.659	0.687
38.70	0.668	0.696	0.727
39.70	0.710	0.731	0.752
40.70	0.752	0.773	0.803
41.70	0.781	0.805	0.834
42.70	0.803	0.830	0.846
43.70	0.832	0.857	0.872
44.70	0.862	0.875	0.899
45.70	0.875	0.895	0.916
46.70	0.894	0.909	0.926
47.70	0.897	0.919	0.933
49.70	0.926	0.940	0.959
51.70	0.947	0.958	0.968
54.70	0.962	0.973	0.981
57.70	0.979	0.985	0.991
61.70	0.984	0.990	0.995
65.70	0.990	0.994	0.997
71.70	0.995	0.998	0.999
79.70	0.998	0.999	1.000
89.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		x = 900mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.003	0.005	0.007
2.70	0.003	0.004	0.006
3.70	0.006	0.008	0.010
5.70	0.014	0.017	0.022
7.70	0.018	0.025	0.032
9.70	0.028	0.033	0.039
11.70	0.038	0.044	0.050
13.70	0.047	0.057	0.069
15.70	0.065	0.077	0.089
17.70	0.093	0.111	0.126
19.70	0.129	0.153	0.173
20.70	0.144	0.186	0.209
21.70	0.186	0.218	0.238
22.70	0.218	0.246	0.289
23.70	0.253	0.294	0.327
24.70	0.282	0.331	0.378
25.70	0.317	0.364	0.435
26.70	0.340	0.394	0.436
27.70	0.399	0.438	0.479
28.70	0.417	0.475	0.512
29.70	0.458	0.503	0.545
30.70	0.485	0.539	0.595
31.70	0.526	0.577	0.622
32.70	0.556	0.602	0.633
33.70	0.593	0.628	0.659
34.70	0.601	0.652	0.689
36.20	0.651	0.687	0.734
37.70	0.692	0.729	0.761

39.20	0.710	0.764	0.795
40.70	0.751	0.781	0.810
42.20	0.778	0.811	0.838
43.70	0.808	0.833	0.853
45.70	0.833	0.865	0.896
47.70	0.855	0.881	0.909
49.70	0.888	0.905	0.925
51.70	0.901	0.917	0.937
54.70	0.921	0.937	0.951
57.70	0.940	0.953	0.969
61.70	0.958	0.969	0.978
67.70	0.979	0.984	0.989
73.70	0.986	0.992	0.995
81.70	0.994	0.997	0.998
91.70	0.998	0.999	1.000
101.70	0.999	1.000	1.000

Step 2 q_w = 0.150m²/s		x = 1000mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.003	0.006	0.007
3.70	0.007	0.011	0.014
5.70	0.022	0.030	0.034
7.70	0.043	0.058	0.070
9.70	0.075	0.092	0.106
11.70	0.111	0.137	0.167
13.70	0.149	0.187	0.221
15.70	0.201	0.236	0.288
17.70	0.222	0.290	0.340
19.70	0.280	0.334	0.381
21.70	0.330	0.381	0.436
23.70	0.386	0.433	0.492
25.70	0.447	0.482	0.550
27.70	0.478	0.527	0.563
29.70	0.513	0.577	0.623
31.70	0.557	0.612	0.650
33.70	0.590	0.648	0.686
35.70	0.640	0.685	0.720
37.70	0.675	0.723	0.758
39.70	0.721	0.758	0.796
41.70	0.749	0.783	0.815
43.70	0.771	0.805	0.832
45.70	0.794	0.826	0.854
48.70	0.837	0.858	0.878
51.70	0.856	0.880	0.892
54.70	0.879	0.903	0.925
57.70	0.905	0.919	0.936
61.70	0.927	0.938	0.948
65.70	0.942	0.951	0.965
71.70	0.959	0.969	0.976
77.70	0.969	0.980	0.985
83.70	0.982	0.988	0.995
91.70	0.991	0.995	0.997
101.70	0.997	0.998	1.000
111.70	0.999	1.000	1.000
121.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s		x = 1200mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.002	0.004	0.007
3.70	0.011	0.017	0.024
5.70	0.042	0.054	0.067
7.70	0.079	0.109	0.127
9.70	0.122	0.168	0.196
11.70	0.198	0.235	0.288
13.70	0.251	0.292	0.342
15.70	0.264	0.344	0.402
17.70	0.358	0.400	0.477
19.70	0.393	0.448	0.508
21.70	0.425	0.493	0.580
23.70	0.455	0.526	0.600
25.70	0.504	0.568	0.611
27.70	0.542	0.617	0.658
29.70	0.578	0.645	0.696
31.70	0.621	0.675	0.728
33.70	0.640	0.704	0.753
35.70	0.684	0.733	0.780
37.70	0.694	0.758	0.791
40.70	0.740	0.783	0.822
43.70	0.789	0.815	0.843
46.70	0.820	0.841	0.866
49.70	0.840	0.862	0.883
52.70	0.853	0.878	0.899
55.70	0.868	0.891	0.910
59.70	0.868	0.912	0.938
63.70	0.897	0.925	0.945
67.70	0.928	0.937	0.953

73.70	0.941	0.950	0.964
81.70	0.955	0.965	0.973
91.70	0.972	0.979	0.984
101.70	0.984	0.989	0.993
111.70	0.990	0.994	0.997
126.70	0.995	0.998	0.999
141.70	0.998	0.999	1.000
156.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		x = 1400mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.002	0.004	0.005
3.70	0.006	0.008	0.011
5.70	0.017	0.021	0.027
7.70	0.028	0.040	0.050
9.70	0.035	0.060	0.082
11.70	0.054	0.080	0.112
13.70	0.095	0.125	0.170
15.70	0.130	0.171	0.236
17.70	0.156	0.230	0.284
19.70	0.219	0.290	0.361
21.70	0.300	0.371	0.430
23.70	0.331	0.435	0.526
25.70	0.401	0.507	0.610
27.70	0.472	0.571	0.638
29.70	0.545	0.641	0.736
31.70	0.624	0.694	0.781
33.70	0.612	0.712	0.782
35.70	0.673	0.749	0.808
37.70	0.709	0.780	0.850
39.70	0.749	0.813	0.868
41.70	0.794	0.836	0.882
43.70	0.827	0.856	0.881
45.70	0.843	0.874	0.911
47.70	0.853	0.887	0.922
49.70	0.866	0.901	0.925
51.70	0.889	0.909	0.929
54.70	0.897	0.919	0.936
57.70	0.915	0.926	0.936
61.70	0.922	0.936	0.952
66.70	0.935	0.946	0.960
73.70	0.947	0.961	0.967
81.70	0.963	0.971	0.977

91.70	0.976	0.982	0.987
101.70	0.984	0.989	0.993
111.70	0.991	0.994	0.998
126.70	0.996	0.998	0.999
141.70	0.998	0.999	1.000
156.70	0.999	1.000	1.000
171.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$		x = 1600mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.002	0.003
3.70	0.003	0.006	0.009
5.70	0.007	0.011	0.013
7.70	0.011	0.017	0.021
9.70	0.020	0.024	0.029
11.70	0.025	0.032	0.037
13.70	0.030	0.040	0.048
15.70	0.045	0.051	0.061
17.70	0.049	0.062	0.075
19.70	0.065	0.079	0.093
21.70	0.077	0.105	0.139
23.70	0.092	0.134	0.237
25.70	0.141	0.180	0.292
27.70	0.181	0.232	0.303
29.70	0.227	0.305	0.381
31.70	0.267	0.388	0.470
33.70	0.349	0.467	0.584
35.70	0.440	0.558	0.704
37.70	0.564	0.658	0.755
39.70	0.631	0.725	0.790
41.70	0.693	0.784	0.858
43.70	0.762	0.840	0.886
45.70	0.801	0.875	0.908
47.70	0.867	0.907	0.934
49.70	0.898	0.928	0.953
51.70	0.902	0.939	0.961
54.70	0.944	0.956	0.966
57.70	0.952	0.967	0.976
61.70	0.963	0.974	0.982
66.70	0.971	0.979	0.986
73.70	0.975	0.985	0.990
81.70	0.985	0.989	0.993
91.70	0.990	0.993	0.996

101.70	0.993	0.996	0.998
116.70	0.997	0.998	0.999
131.70	0.998	0.999	0.999
146.70	0.999	1.000	1.000

Step 2 q_w = 0.150m²/s		x = 1800mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
3.70	0.000	0.001	0.002
5.70	0.001	0.002	0.003
7.70	0.002	0.003	0.005
10.70	0.004	0.005	0.009
13.70	0.006	0.009	0.013
16.70	0.010	0.013	0.018
19.70	0.015	0.020	0.028
22.70	0.033	0.038	0.048
25.70	0.043	0.054	0.076
28.70	0.065	0.079	0.096
31.70	0.093	0.128	0.156
33.70	0.131	0.172	0.211
34.70	0.168	0.216	0.268
35.70	0.211	0.257	0.306
36.70	0.223	0.293	0.345
37.70	0.291	0.342	0.403
38.70	0.309	0.373	0.428
39.70	0.350	0.413	0.510
40.70	0.413	0.473	0.534
41.70	0.458	0.531	0.585
42.70	0.500	0.585	0.657
43.70	0.542	0.648	0.708
44.70	0.640	0.684	0.754
45.70	0.617	0.708	0.791
46.70	0.667	0.739	0.792
47.70	0.697	0.769	0.822
48.70	0.754	0.808	0.859
49.70	0.782	0.835	0.880
51.70	0.852	0.882	0.917
53.70	0.881	0.908	0.935
55.70	0.894	0.926	0.960
58.70	0.921	0.948	0.969
61.70	0.960	0.971	0.980
65.70	0.977	0.987	0.994
69.70	0.985	0.992	0.996
75.70	0.993	0.996	0.998
81.70	0.995	0.998	1.000
91.70	0.997	0.999	1.000
101.70	0.998	0.999	1.000
116.70	0.998	1.000	1.000
131.70	0.999	1.000	1.000

Step 2 q_w = 0.150m²/s		x = 2000mm, y = 0mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
4.70	0.000	0.001	0.003
7.70	0.003	0.004	0.005
10.70	0.004	0.006	0.008
13.70	0.005	0.009	0.012
16.70	0.010	0.014	0.018
19.70	0.015	0.022	0.027
21.70	0.022	0.029	0.040
23.70	0.030	0.038	0.044
25.70	0.041	0.051	0.060
27.70	0.046	0.070	0.091
29.70	0.073	0.098	0.137
31.70	0.101	0.132	0.186
33.70	0.131	0.187	0.235
35.70	0.185	0.276	0.352
37.70	0.282	0.366	0.470
39.70	0.345	0.440	0.537
41.70	0.392	0.513	0.635
43.70	0.506	0.619	0.733
45.70	0.566	0.665	0.777
47.70	0.613	0.737	0.831
49.70	0.671	0.777	0.861
51.70	0.742	0.844	0.934
53.70	0.805	0.863	0.926
55.70	0.833	0.890	0.906
57.70	0.897	0.924	0.961
60.70	0.920	0.953	0.975
63.70	0.959	0.977	0.989
67.70	0.972	0.985	0.995
73.70	0.989	0.995	0.998
81.70	0.996	0.998	1.000
91.70	0.998	0.999	1.000
101.70	0.999	1.000	1.000
111.70	1.000	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 2200$mm, $y = 0$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
4.70	0.000	0.001	0.002
7.70	0.001	0.002	0.003
10.70	0.002	0.004	0.006
13.70	0.004	0.006	0.009
16.70	0.006	0.009	0.012
19.70	0.010	0.014	0.020
22.70	0.018	0.023	0.028
25.70	0.028	0.041	0.052
27.70	0.040	0.068	0.101
28.70	0.058	0.085	0.130
29.70	0.062	0.103	0.165
31.70	0.114	0.172	0.264
32.70	0.128	0.218	0.312
33.70	0.154	0.257	0.357
34.70	0.181	0.320	0.436
35.70	0.236	0.342	0.454
36.70	0.256	0.386	0.540
37.70	0.316	0.453	0.669
38.70	0.349	0.514	0.676
39.70	0.399	0.586	0.684
40.70	0.548	0.643	0.759
41.70	0.494	0.640	0.760
42.70	0.498	0.703	0.826
43.70	0.586	0.743	0.837
44.70	0.643	0.788	0.890
45.70	0.716	0.802	0.892
46.70	0.713	0.835	0.909
47.70	0.745	0.841	0.921
49.70	0.802	0.892	0.943
51.70	0.875	0.931	0.977
53.70	0.903	0.947	0.976
55.70	0.929	0.963	0.988
58.70	0.961	0.981	0.993
61.70	0.975	0.987	0.995
66.70	0.990	0.996	0.999
73.70	0.993	0.997	1.000
81.70	0.997	0.999	1.000
91.70	0.999	1.000	1.000
101.70	0.999	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 2400$mm, $y = 0$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
0.75	0.000	0.000	0.000
5.75	0.000	0.001	0.002
10.75	0.001	0.002	0.004
15.75	0.002	0.004	0.006
20.75	0.006	0.009	0.012
23.75	0.010	0.017	0.025
25.75	0.017	0.030	0.051
27.75	0.033	0.061	0.091
29.75	0.061	0.106	0.180
30.75	0.068	0.141	0.204
31.75	0.092	0.184	0.292
32.75	0.147	0.234	0.326
33.75	0.169	0.278	0.415
34.75	0.197	0.337	0.470
35.75	0.311	0.400	0.519
36.75	0.351	0.479	0.618
37.75	0.439	0.549	0.665
38.75	0.522	0.600	0.691
39.75	0.569	0.651	0.729
40.75	0.590	0.697	0.799
41.75	0.662	0.749	0.835
42.75	0.736	0.790	0.853
43.75	0.792	0.827	0.896
44.75	0.827	0.860	0.915
45.75	0.853	0.885	0.925
46.75	0.872	0.911	0.942
48.75	0.920	0.945	0.970
50.75	0.955	0.970	0.984
52.75	0.971	0.982	0.989
54.75	0.985	0.990	0.995
57.75	0.989	0.995	0.998
60.75	0.993	0.997	1.000
64.75	0.996	0.998	1.000
68.75	0.997	0.999	1.000
74.75	0.998	0.999	1.000
80.75	0.998	1.000	1.000
90.75	0.999	1.000	1.000
100.75	0.999	1.000	1.000

Table H-4 Single-tip conductivity probe data: Experiment ST2 (Step 2, $q_w = 0.150\text{m}^2/\text{s}$, $Y = 0.7$)

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 0\text{mm}$, $y = 175\text{mm}$

z [mm]	C (5s of 180s) Min	Mean	Max
0.75	0.000	0.000	0.000
10.75	0.000	0.001	0.002
12.75	0.000	0.001	0.003
14.75	0.001	0.002	0.003
16.75	0.004	0.007	0.010
18.75	0.019	0.024	0.031
19.75	0.039	0.050	0.061
20.75	0.077	0.091	0.114
21.75	0.149	0.164	0.184
22.75	0.245	0.269	0.297
23.75	0.356	0.391	0.415
24.75	0.483	0.531	0.569
25.75	0.617	0.655	0.687
26.75	0.738	0.756	0.773
27.75	0.829	0.850	0.867
28.75	0.884	0.905	0.918
29.75	0.930	0.942	0.951
30.75	0.964	0.971	0.979
31.75	0.977	0.984	0.989
32.75	0.988	0.992	0.995
34.75	0.996	0.998	0.999
36.75	0.999	0.999	1.000
38.75	0.999	1.000	1.000
40.75	0.999	1.000	1.000
43.75	1.000	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 20\text{mm}$, $y = 175\text{mm}$

z [mm]	C (5s of 180s) Min	Mean	Max
1.70	0.000	0.000	0.000
3.70	0.000	0.000	0.000
3.95	0.004	0.004	0.024
4.20	0.013	0.066	0.133
4.45	0.229	0.497	0.805
4.70	0.924	0.971	0.998
4.95	0.978	0.999	1.000
5.20	1.000	1.000	1.000
126.70	1.000	1.000	1.000
128.70	0.994	0.993	0.995
129.20	0.846	0.862	0.881
129.70	0.800	0.825	0.838
130.20	0.779	0.795	0.807
130.70	0.299	0.324	0.364
131.20	0.140	0.183	0.223
131.70	0.136	0.152	0.176
132.20	0.019	0.027	0.043
132.70	0.003	0.006	0.009
133.70	0.000	0.001	0.001
135.70	0.000	0.000	0.001
139.70	0.000	0.000	0.001
141.70	0.000	0.001	0.002
144.70	0.002	0.004	0.006
147.70	0.015	0.022	0.030
149.70	0.064	0.080	0.097
150.70	0.092	0.147	0.183
151.70	0.206	0.237	0.257
152.70	0.277	0.304	0.328
153.70	0.449	0.471	0.494
154.70	0.541	0.568	0.593
155.70	0.675	0.700	0.717
156.70	0.752	0.780	0.802
157.70	0.836	0.856	0.879
158.70	0.896	0.911	0.922
159.70	0.932	0.950	0.958
160.70	0.966	0.972	0.978
161.70	0.977	0.986	0.991
163.70	0.994	0.996	0.999
165.70	0.998	0.999	1.000
167.70	0.999	1.000	1.000
169.70	1.000	1.000	1.000
171.70	1.000	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 200\text{mm}$, $y = 175\text{mm}$

z [mm]	C (5s of 180s) Min	Mean	Max
1.70	0.000	0.000	0.000
4.70	0.000	0.001	0.007
5.20	0.011	0.050	0.117
5.45	0.057	0.180	0.352
5.70	0.198	0.436	0.588
5.95	0.336	0.626	0.781
6.20	0.695	0.856	0.938
6.45	0.826	0.947	0.996

6.70	0.868	0.988	1.000
7.20	0.999	1.000	1.000
7.70	1.000	1.000	1.000
91.70	0.999	1.000	1.000
94.70	0.998	0.999	1.000
97.70	0.996	0.998	1.000
100.70	0.988	0.993	0.997
103.70	0.973	0.981	0.990
106.70	0.937	0.952	0.967
109.70	0.896	0.914	0.932
112.70	0.834	0.850	0.889
115.70	0.690	0.719	0.749
117.70	0.537	0.573	0.604
119.70	0.340	0.417	0.439
121.70	0.261	0.285	0.314
123.70	0.164	0.200	0.224
125.70	0.109	0.124	0.138
127.70	0.068	0.078	0.086
129.70	0.049	0.059	0.073
131.70	0.046	0.054	0.068
133.70	0.058	0.066	0.076
135.70	0.074	0.094	0.113
137.70	0.124	0.137	0.157
139.70	0.183	0.208	0.245
141.70	0.262	0.289	0.320
143.70	0.365	0.402	0.437
145.70	0.518	0.540	0.585
147.70	0.649	0.670	0.687
149.70	0.763	0.778	0.802
151.70	0.847	0.867	0.878
153.70	0.919	0.929	0.944
155.70	0.954	0.964	0.975
157.70	0.975	0.981	0.987
159.70	0.987	0.991	0.994
161.70	0.994	0.997	0.999
164.70	0.998	0.999	1.000
167.70	0.999	1.000	1.000
171.70	1.000	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 400$mm, $y = 175$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.009	0.038	0.118
2.70	0.033	0.104	0.237
3.20	0.080	0.207	0.391
3.70	0.246	0.389	0.528
4.20	0.435	0.547	0.696
4.70	0.616	0.714	0.863
5.20	0.683	0.812	0.880
5.70	0.740	0.878	0.951
6.70	0.931	0.955	0.978
7.70	0.956	0.977	0.992
9.70	0.986	0.995	0.999
11.70	0.990	0.998	1.000
16.70	0.999	1.000	1.000
21.70	0.999	1.000	1.000
31.70	0.999	0.999	1.000
35.70	0.996	0.998	1.000
39.70	0.982	0.993	0.996
43.70	0.970	0.983	0.992
47.70	0.933	0.956	0.973
51.70	0.890	0.919	0.942
55.70	0.801	0.843	0.882
59.70	0.784	0.816	0.851
63.70	0.700	0.740	0.805
67.70	0.647	0.696	0.749
71.70	0.523	0.578	0.651
75.70	0.439	0.475	0.509
79.70	0.331	0.371	0.403
83.70	0.261	0.290	0.328
87.70	0.254	0.274	0.302
91.70	0.251	0.273	0.296
95.70	0.283	0.319	0.357
99.70	0.333	0.358	0.385
103.70	0.416	0.446	0.482
107.70	0.473	0.520	0.565
111.70	0.596	0.640	0.681
115.70	0.693	0.738	0.777
119.70	0.807	0.829	0.854
123.70	0.886	0.903	0.921
127.70	0.939	0.953	0.964
131.70	0.977	0.982	0.988
135.70	0.987	0.992	0.995
141.70	0.996	0.999	1.000
147.70	0.999	1.000	1.000
153.70	1.000	1.000	1.000
161.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s	x = 500mm, y = 175mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.709	0.743	0.765
3.70	0.805	0.835	0.861
5.70	0.876	0.903	0.919
7.70	0.901	0.926	0.943
9.70	0.899	0.934	0.947
11.70	0.916	0.937	0.955
13.70	0.905	0.932	0.955
17.70	0.873	0.893	0.917
21.70	0.829	0.861	0.887
25.70	0.748	0.789	0.826
29.70	0.711	0.754	0.796
33.70	0.633	0.663	0.695
37.70	0.575	0.629	0.688
41.70	0.503	0.541	0.616
45.70	0.445	0.485	0.551
49.70	0.384	0.422	0.475
53.70	0.349	0.370	0.398
57.70	0.323	0.352	0.377
61.70	0.320	0.354	0.379
65.70	0.330	0.362	0.394
69.70	0.362	0.393	0.452
73.70	0.376	0.412	0.447
77.70	0.405	0.455	0.493
81.70	0.440	0.484	0.508
85.70	0.498	0.540	0.590
89.70	0.556	0.591	0.632
93.70	0.644	0.674	0.736
97.70	0.697	0.735	0.762
101.70	0.793	0.824	0.865
105.70	0.860	0.884	0.902
109.70	0.911	0.934	0.954
113.70	0.955	0.965	0.980
117.70	0.981	0.986	0.992
121.70	0.988	0.993	0.996
125.70	0.995	0.997	0.999
129.70	0.997	0.999	1.000
135.70	0.999	1.000	1.000
141.70	0.999	1.000	1.000
147.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s	x = 600mm, y = 175mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.019	0.026	0.033
3.70	0.022	0.030	0.035
5.70	0.045	0.058	0.066
7.70	0.067	0.080	0.098
9.70	0.084	0.097	0.113
11.70	0.106	0.121	0.139
13.70	0.109	0.141	0.167
15.70	0.161	0.183	0.203
17.70	0.206	0.238	0.267
19.70	0.246	0.279	0.312
21.70	0.303	0.320	0.344
23.70	0.336	0.365	0.395
25.70	0.371	0.390	0.419
27.70	0.384	0.415	0.451
29.70	0.401	0.421	0.453
31.70	0.418	0.446	0.472
33.70	0.418	0.456	0.486
35.70	0.409	0.455	0.483
37.70	0.439	0.462	0.490
39.70	0.461	0.486	0.511
41.70	0.477	0.503	0.534
43.70	0.452	0.495	0.520
45.70	0.473	0.501	0.525
47.70	0.509	0.536	0.568
49.70	0.509	0.540	0.578
51.70	0.509	0.541	0.575
53.70	0.524	0.556	0.585
55.70	0.528	0.590	0.623
57.70	0.563	0.608	0.649
59.70	0.562	0.599	0.636
61.70	0.610	0.642	0.682
64.70	0.637	0.666	0.696
67.70	0.656	0.701	0.752
70.70	0.706	0.751	0.818
73.70	0.760	0.794	0.820
76.70	0.803	0.845	0.876
79.70	0.864	0.882	0.902
82.70	0.889	0.913	0.932
85.70	0.924	0.940	0.959
88.70	0.943	0.958	0.971
91.70	0.956	0.969	0.978
95.70	0.982	0.987	0.991

99.70	0.988	0.992	0.995
105.70	0.994	0.998	0.999
111.70	0.999	0.999	1.000
117.70	0.999	1.000	1.000
123.70	1.000	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ $x = 700mm, y = 175mm$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.002	0.003	0.004
3.70	0.003	0.004	0.007
5.70	0.008	0.010	0.015
7.70	0.013	0.017	0.020
9.70	0.020	0.023	0.027
11.70	0.025	0.030	0.035
13.70	0.029	0.035	0.041
15.70	0.036	0.047	0.054
17.70	0.047	0.056	0.066
19.70	0.061	0.070	0.080
21.70	0.079	0.093	0.105
23.70	0.121	0.135	0.157
25.70	0.163	0.191	0.226
27.70	0.217	0.250	0.290
29.70	0.287	0.344	0.389
31.70	0.394	0.458	0.504
33.70	0.504	0.548	0.590
35.70	0.571	0.604	0.646
37.70	0.629	0.670	0.707
39.70	0.679	0.738	0.800
41.70	0.745	0.783	0.811
43.70	0.758	0.799	0.837
45.70	0.788	0.837	0.858
47.70	0.834	0.870	0.909
49.70	0.866	0.887	0.911
51.70	0.869	0.897	0.914
54.70	0.906	0.922	0.939
57.70	0.935	0.952	0.965
61.70	0.943	0.967	0.978
65.70	0.965	0.981	0.990
71.70	0.987	0.992	0.995
77.70	0.993	0.997	0.999
83.70	0.997	0.999	1.000
91.70	0.999	1.000	1.000
101.70	1.000	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ $x = 800mm, y = 175mm$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.002	0.002
3.70	0.003	0.005	0.008
5.70	0.008	0.010	0.012
7.70	0.012	0.016	0.021
9.70	0.022	0.028	0.035
11.70	0.043	0.052	0.066
13.70	0.064	0.081	0.104
14.70	0.092	0.112	0.136
15.70	0.113	0.140	0.167
16.70	0.155	0.188	0.222
17.70	0.189	0.224	0.263
18.70	0.220	0.270	0.323
19.70	0.297	0.332	0.406
20.70	0.335	0.374	0.416
21.70	0.347	0.407	0.466
22.70	0.391	0.478	0.538
23.70	0.450	0.509	0.547
24.70	0.508	0.556	0.602
25.70	0.574	0.606	0.639
26.70	0.584	0.634	0.681
27.70	0.654	0.685	0.722
28.70	0.681	0.715	0.747
29.70	0.694	0.735	0.767
30.70	0.725	0.774	0.802
31.70	0.766	0.800	0.821
33.70	0.813	0.843	0.872
35.70	0.857	0.873	0.890
37.70	0.874	0.901	0.925
39.70	0.904	0.928	0.938
41.70	0.933	0.944	0.955
44.70	0.950	0.960	0.968
47.70	0.967	0.974	0.983
51.70	0.979	0.985	0.990
55.70	0.988	0.991	0.995
59.70	0.992	0.995	0.997
65.70	0.997	0.998	0.999
71.70	0.998	0.999	1.000
79.70	0.999	1.000	1.000
87.70	1.000	1.000	1.000
96.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s	x = 1000mm, y = 175mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.003	0.005	0.010
2.70	0.008	0.013	0.018
3.70	0.021	0.031	0.047
4.70	0.041	0.060	0.078
5.70	0.075	0.105	0.146
6.70	0.093	0.138	0.170
7.70	0.114	0.165	0.204
8.70	0.160	0.211	0.252
9.70	0.196	0.241	0.270
10.70	0.233	0.282	0.321
11.70	0.285	0.322	0.400
12.70	0.291	0.350	0.391
13.70	0.329	0.380	0.422
14.70	0.355	0.410	0.495
15.70	0.369	0.435	0.489
16.70	0.423	0.470	0.518
17.70	0.410	0.479	0.530
18.70	0.448	0.507	0.554
19.70	0.496	0.538	0.605
20.70	0.503	0.569	0.612
21.70	0.546	0.597	0.636
23.70	0.592	0.634	0.688
25.70	0.653	0.687	0.718
27.70	0.668	0.729	0.774
29.70	0.705	0.750	0.777
31.70	0.746	0.781	0.837
33.70	0.785	0.812	0.850
35.70	0.801	0.837	0.862
37.70	0.833	0.854	0.872
39.70	0.848	0.871	0.892
41.70	0.877	0.892	0.916
43.70	0.890	0.905	0.918
46.70	0.911	0.926	0.943
49.70	0.928	0.941	0.953
53.70	0.944	0.953	0.959
57.70	0.960	0.968	0.976
61.70	0.969	0.976	0.982
67.70	0.981	0.984	0.988
73.70	0.988	0.992	0.996
81.70	0.993	0.996	0.997
91.70	0.996	0.998	0.999
101.70	0.998	0.999	1.000
116.70	0.999	1.000	1.000
131.70	0.999	1.000	1.000
146.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s	x = 1200mm, y = 175mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.002	0.003
3.70	0.006	0.009	0.012
5.70	0.013	0.020	0.030
7.70	0.030	0.046	0.060
9.70	0.078	0.098	0.118
10.70	0.107	0.134	0.160
11.70	0.148	0.175	0.232
12.70	0.175	0.219	0.285
13.70	0.218	0.261	0.321
14.70	0.273	0.329	0.399
15.70	0.313	0.370	0.438
16.70	0.359	0.423	0.480
17.70	0.402	0.469	0.516
18.70	0.461	0.520	0.587
19.70	0.510	0.556	0.618
20.70	0.559	0.611	0.663
21.70	0.593	0.642	0.697
22.70	0.622	0.681	0.753
23.70	0.667	0.712	0.749
24.70	0.676	0.737	0.791
25.70	0.723	0.764	0.809
26.70	0.731	0.776	0.811
27.70	0.770	0.799	0.831
28.70	0.771	0.817	0.848
29.70	0.772	0.827	0.866
31.70	0.810	0.853	0.883
33.70	0.849	0.871	0.914
35.70	0.871	0.889	0.911
37.70	0.881	0.901	0.925
41.70	0.914	0.927	0.944
45.70	0.928	0.944	0.958
51.70	0.951	0.964	0.977
57.70	0.967	0.975	0.985
63.70	0.978	0.984	0.990
71.70	0.987	0.991	0.995
81.70	0.992	0.995	0.998
91.70	0.996	0.998	0.999

106.70	0.998	0.999	1.000
121.70	0.999	1.000	1.000
141.70	1.000	1.000	1.000
161.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s x = 1400mm, y = 175mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.002	0.002
4.70	0.004	0.005	0.003
7.70	0.007	0.010	0.014
10.70	0.018	0.024	0.035
12.70	0.028	0.042	0.060
13.70	0.039	0.058	0.079
14.70	0.045	0.071	0.093
15.70	0.068	0.093	0.127
16.70	0.089	0.122	0.174
17.70	0.118	0.146	0.198
18.70	0.132	0.172	0.209
19.70	0.164	0.198	0.236
20.70	0.192	0.231	0.269
21.70	0.219	0.270	0.323
22.70	0.276	0.311	0.357
23.70	0.278	0.327	0.413
24.70	0.317	0.373	0.420
25.70	0.345	0.386	0.461
26.70	0.361	0.429	0.501
27.70	0.430	0.472	0.527
28.70	0.403	0.491	0.563
29.70	0.499	0.539	0.580
30.70	0.532	0.585	0.681
31.70	0.534	0.585	0.642
32.70	0.595	0.643	0.691
33.70	0.630	0.664	0.714
34.70	0.663	0.694	0.739
35.70	0.689	0.742	0.785
36.70	0.713	0.760	0.805
37.70	0.751	0.794	0.842
38.70	0.796	0.827	0.854
39.70	0.811	0.848	0.879
40.70	0.836	0.872	0.903
41.70	0.858	0.888	0.912
42.70	0.877	0.903	0.941
43.70	0.886	0.917	0.937
45.70	0.914	0.939	0.959
47.70	0.947	0.956	0.972
49.70	0.954	0.969	0.979
52.70	0.971	0.981	0.988
55.70	0.984	0.987	0.993
60.70	0.989	0.993	0.996
66.70	0.992	0.995	0.998
73.70	0.995	0.997	0.999
81.70	0.996	0.998	0.999
91.70	0.998	0.999	1.000
106.70	0.999	0.999	1.000
121.70	0.999	1.000	1.000
141.70	1.000	1.000	1.000
161.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s x = 1600mm, y = 175mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.002
4.70	0.003	0.004	0.006
7.70	0.007	0.010	0.013
10.70	0.018	0.021	0.026
13.70	0.030	0.041	0.050
15.70	0.048	0.059	0.076
17.70	0.058	0.078	0.091
19.70	0.070	0.104	0.130
21.70	0.119	0.134	0.153
22.70	0.118	0.148	0.176
23.70	0.131	0.169	0.198
24.70	0.162	0.190	0.213
25.70	0.180	0.205	0.230
26.70	0.200	0.225	0.259
27.70	0.208	0.252	0.296
28.70	0.253	0.292	0.348
29.70	0.280	0.322	0.361
30.70	0.319	0.355	0.410
31.70	0.348	0.394	0.456
32.70	0.380	0.432	0.485
33.70	0.412	0.466	0.532
34.70	0.483	0.521	0.562
35.70	0.531	0.575	0.608
36.70	0.529	0.603	0.655
37.70	0.580	0.649	0.715
38.70	0.621	0.687	0.729

39.70	0.649	0.728	0.782
40.70	0.687	0.763	0.801
41.70	0.737	0.794	0.839
42.70	0.759	0.813	0.861
43.70	0.803	0.845	0.884
44.70	0.838	0.870	0.897
45.70	0.851	0.887	0.933
46.70	0.882	0.911	0.936
47.70	0.897	0.921	0.941
49.70	0.925	0.944	0.961
51.70	0.938	0.962	0.978
53.70	0.956	0.972	0.982
56.70	0.977	0.984	0.990
59.70	0.982	0.990	0.995
63.70	0.991	0.996	0.998
67.70	0.996	0.998	0.999
71.70	0.996	0.999	1.000
77.70	0.997	0.999	1.000
83.70	0.999	1.000	1.000
91.70	0.999	1.000	1.000
101.70	0.999	1.000	1.000
111.70	0.999	1.000	1.000
126.70	0.999	1.000	1.000
141.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s x = 1800mm, y = 175mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.002
3.70	0.003	0.004	0.007
5.70	0.007	0.009	0.012
7.70	0.012	0.016	0.019
9.70	0.019	0.025	0.030
11.70	0.030	0.035	0.042
13.70	0.040	0.047	0.056
15.70	0.050	0.066	0.078
17.70	0.076	0.089	0.101
19.70	0.093	0.109	0.127
21.70	0.116	0.139	0.163
23.70	0.148	0.172	0.194
25.70	0.187	0.225	0.261
27.70	0.243	0.274	0.320
28.70	0.276	0.325	0.378
29.70	0.289	0.342	0.393
30.70	0.311	0.394	0.442
31.70	0.378	0.441	0.507
32.70	0.425	0.481	0.549
33.70	0.486	0.532	0.582
34.70	0.504	0.565	0.627
35.70	0.539	0.609	0.651
36.70	0.595	0.655	0.719
37.70	0.634	0.696	0.735
38.70	0.674	0.728	0.778
39.70	0.699	0.759	0.807
40.70	0.709	0.779	0.845
41.70	0.775	0.823	0.866
43.70	0.799	0.863	0.895
45.70	0.870	0.904	0.929
47.70	0.904	0.934	0.963
49.70	0.921	0.956	0.974
51.70	0.950	0.968	0.982
54.70	0.970	0.982	0.992
57.70	0.985	0.991	0.995
60.70	0.990	0.995	0.998
63.70	0.994	0.997	1.000
67.70	0.997	0.998	1.000
71.70	0.998	0.999	1.000
77.70	0.999	1.000	1.000
83.70	0.999	1.000	1.000
91.70	0.999	1.000	1.000
101.70	0.999	1.000	1.000

Step 2 q_w = 0.150m²/s x = 2000mm, y = 175mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
5.70	0.001	0.002	0.002
8.70	0.003	0.004	0.005
11.70	0.005	0.007	0.008
14.70	0.009	0.011	0.013
17.70	0.013	0.016	0.021
20.70	0.021	0.024	0.028
23.70	0.026	0.035	0.043
25.70	0.037	0.043	0.052
27.70	0.054	0.065	0.087
29.70	0.081	0.098	0.126
31.70	0.106	0.138	0.167
33.70	0.149	0.212	0.260

34.70	0.217	0.270	0.321
35.70	0.278	0.327	0.404
36.70	0.299	0.365	0.433
37.70	0.358	0.430	0.531
38.70	0.401	0.488	0.574
39.70	0.455	0.539	0.606
40.70	0.550	0.604	0.723
41.70	0.575	0.652	0.728
42.70	0.601	0.696	0.760
43.70	0.666	0.751	0.808
44.70	0.703	0.774	0.834
45.70	0.770	0.808	0.852
46.70	0.774	0.848	0.888
47.70	0.813	0.875	0.908
48.70	0.868	0.908	0.936
49.70	0.885	0.920	0.951
50.70	0.888	0.926	0.960
51.70	0.911	0.951	0.973
53.70	0.944	0.965	0.980
55.70	0.962	0.979	0.991
57.70	0.966	0.987	0.995
60.70	0.990	0.994	0.999
63.70	0.995	0.997	0.999
67.70	0.998	0.999	1.000
71.70	0.999	0.999	1.000
77.70	0.999	1.000	1.000
83.70	0.999	1.000	1.000
91.70	1.000	1.000	1.000
101.70	1.000	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ $x = 2200mm, y = 175mm$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
6.70	0.001	0.001	0.002
11.70	0.003	0.004	0.005
16.70	0.005	0.008	0.011
19.70	0.009	0.012	0.014
22.70	0.012	0.016	0.020
25.70	0.019	0.023	0.027
27.70	0.028	0.034	0.041
29.70	0.036	0.051	0.054
31.70	0.071	0.086	0.116
32.70	0.083	0.108	0.140
33.70	0.100	0.147	0.178
34.70	0.137	0.176	0.229
35.70	0.170	0.214	0.258
36.70	0.204	0.265	0.314
37.70	0.263	0.316	0.376
38.70	0.346	0.384	0.452
39.70	0.368	0.453	0.507
40.70	0.432	0.495	0.557
41.70	0.501	0.574	0.620
42.70	0.545	0.624	0.695
43.70	0.577	0.676	0.724
44.70	0.653	0.730	0.797
45.70	0.711	0.766	0.811
46.70	0.770	0.807	0.845
47.70	0.808	0.856	0.903
48.70	0.831	0.875	0.921
49.70	0.856	0.900	0.931
51.70	0.913	0.933	0.950
53.70	0.945	0.965	0.976
55.70	0.966	0.981	0.992
58.70	0.987	0.993	0.996
61.70	0.994	0.997	0.999
65.70	0.997	0.999	1.000
69.70	0.999	1.000	1.000
75.70	0.999	1.000	1.000
81.70	1.000	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ $x = 2400mm, y = 175mm$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
0.75	0.000	0.000	0.000
5.75	0.000	0.001	0.002
10.75	0.002	0.003	0.004
15.75	0.004	0.005	0.007
18.75	0.006	0.008	0.011
21.75	0.009	0.011	0.014
24.75	0.014	0.017	0.024
26.75	0.020	0.025	0.033
28.75	0.033	0.046	0.065
30.75	0.061	0.081	0.106
31.75	0.066	0.109	0.146
32.75	0.103	0.144	0.173
33.75	0.149	0.195	0.226
34.75	0.180	0.237	0.280

35.75	0.222	0.289	0.349
36.75	0.309	0.362	0.415
37.75	0.369	0.417	0.481
38.75	0.407	0.476	0.573
39.75	0.486	0.541	0.619
40.75	0.552	0.613	0.692
41.75	0.636	0.672	0.747
42.75	0.679	0.731	0.776
43.75	0.685	0.779	0.837
44.75	0.776	0.819	0.861
45.75	0.809	0.854	0.892
46.75	0.859	0.889	0.934
47.75	0.867	0.908	0.944
48.75	0.918	0.935	0.953
50.75	0.943	0.965	0.984
52.75	0.958	0.983	0.992
54.75	0.981	0.990	0.996
57.75	0.995	0.998	1.000
60.75	0.997	0.999	1.000
64.75	0.998	1.000	1.000
68.75	1.000	1.000	1.000
74.75	1.000	1.000	1.000
66.75	0.999	1.000	1.000
70.75	1.000	1.000	1.000

Table H-5 Single-tip conductivity probe data: Experiment ST3 (Step 2, $q_w = 0.150$m²/s, $Y = 0.99$)

Step 2 $q_w = 0.150$m²/s		$x = 0$mm, $y = 248$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
0.75	0.044	0.086	0.154
1.75	1.000	1.000	1.000
2.75	0.347	0.439	0.489
3.75	0.950	0.969	0.986
4.75	0.500	0.529	0.565
5.75	0.000	0.000	0.000
10.75	0.000	0.000	0.001
15.75	0.001	0.002	0.004
20.75	0.005	0.007	0.010
22.75	0.026	0.046	0.068
23.75	0.088	0.112	0.136
24.75	0.142	0.203	0.273
25.75	0.222	0.328	0.414
26.75	0.353	0.456	0.521
27.75	0.503	0.566	0.644
28.75	0.589	0.665	0.714
29.75	0.781	0.813	0.851
30.75	0.849	0.914	0.958
31.75	0.922	0.949	0.962
32.75	0.953	0.969	0.988
33.75	0.926	0.947	0.971
34.75	0.984	0.994	0.999
35.75	0.943	0.956	0.970
36.75	0.996	0.999	1.000
37.75	0.997	0.994	0.999
38.75	0.970	0.985	0.994
39.75	0.978	0.987	0.993
40.75	0.993	0.998	1.000
42.75	0.998	1.000	1.000
44.75	0.990	0.997	1.000
48.75	0.999	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 20$mm, $y = 248$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
5.95	0.000	0.000	0.000
6.20	0.000	0.007	0.058
6.45	0.013	0.347	0.658
6.70	0.762	0.946	1.000
6.95	0.113	0.729	1.000
7.20	0.225	0.658	0.972
7.45	0.401	0.758	0.999
7.70	0.483	0.850	1.000
7.95	0.993	1.000	1.000
8.20	1.000	1.000	1.000
126.70	1.000	1.000	1.000
127.70	0.994	0.998	1.000
128.70	1.000	1.000	1.000
129.70	0.996	0.999	1.000
130.70	0.996	0.998	1.000
131.70	1.000	1.000	1.000

132.70	0.968	0.982	0.991
133.70	0.987	0.994	0.998
134.70	0.993	0.997	0.999
135.70	0.773	0.870	0.913
136.70	0.974	0.986	0.991
137.20	0.554	0.621	0.654
137.70	0.685	0.708	0.731
138.70	0.393	0.445	0.574
139.70	0.862	0.902	0.987
140.70	0.211	0.414	0.701
141.70	0.164	0.315	0.587
142.70	0.156	0.212	0.453
143.70	0.010	0.017	0.031
145.70	0.011	0.016	0.024
147.70	0.006	0.008	0.010
147.70	0.006	0.008	0.010
149.70	0.018	0.028	0.040
151.70	0.054	0.079	0.098
152.70	0.072	0.094	0.125
153.70	0.142	0.174	0.214
154.70	0.260	0.332	0.397
155.70	0.346	0.399	0.444
156.70	0.538	0.585	0.634
157.70	0.681	0.726	0.773
158.70	0.748	0.794	0.839
159.70	0.867	0.893	0.920
161.70	0.945	0.964	0.983
163.70	0.981	0.991	0.996
165.70	0.989	0.996	0.998
167.70	0.994	0.998	1.000
171.70	0.997	0.999	1.000
173.70	0.998	0.999	1.000
176.70	0.999	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$	$x = 200\text{mm}$, $y = 248\text{mm}$		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.002
3.70	0.000	0.007	0.018
3.95	0.000	0.021	0.070
4.20	0.017	0.043	0.085
4.70	0.050	0.092	0.150
5.20	0.124	0.218	0.331
5.70	0.238	0.362	0.423
6.20	0.387	0.544	0.658
6.70	0.580	0.738	0.845
7.20	0.672	0.797	0.900
7.70	0.878	0.959	0.997
8.20	0.977	0.995	1.000
8.70	0.983	0.999	1.000
9.70	1.000	1.000	1.000
76.70	1.000	1.000	1.000
79.70	0.998	1.000	1.000
84.70	0.998	0.999	1.000
88.70	0.992	0.996	0.999
91.70	0.974	0.983	0.993
93.70	0.969	0.984	0.990
95.70	0.930	0.962	0.978
97.70	0.772	0.827	0.868
99.70	0.837	0.867	0.905
101.70	0.841	0.877	0.920
103.70	0.729	0.761	0.789
105.70	0.375	0.442	0.534
107.70	0.494	0.544	0.615
109.70	0.406	0.467	0.546
111.70	0.311	0.374	0.450
113.70	0.217	0.270	0.308
115.70	0.278	0.339	0.407
117.70	0.252	0.313	0.363
119.70	0.271	0.335	0.409
121.70	0.353	0.397	0.452
123.70	0.428	0.480	0.523
125.70	0.433	0.572	0.638
127.70	0.570	0.635	0.710
129.70	0.654	0.728	0.809
131.70	0.751	0.803	0.838
133.70	0.833	0.873	0.913
135.70	0.841	0.904	0.930
137.70	0.928	0.951	0.970
139.70	0.951	0.965	0.982
141.70	0.969	0.981	0.996
143.70	0.985	0.990	0.996
145.70	0.991	0.994	0.999
148.70	0.992	0.997	1.000
151.70	0.996	0.999	1.000
155.70	0.998	0.999	1.000
161.70	1.000	1.000	1.000

Step 2 $q_w = 0.150m^2/s$	$x = 300mm, y = 248mm$		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.965	0.995	1.000
6.70	0.999	1.000	1.000
11.70	0.997	0.999	1.000
16.70	0.996	0.999	1.000
21.70	0.993	0.998	1.000
26.70	0.994	0.998	1.000
31.70	0.987	0.993	0.997
36.70	0.980	0.987	0.993
41.70	0.960	0.974	0.987
44.20	0.972	0.984	0.994
46.70	0.932	0.949	0.969
49.20	0.963	0.975	0.987
51.70	0.850	0.876	0.902
54.20	0.930	0.952	0.971
56.70	0.748	0.794	0.834
59.20	0.851	0.886	0.920
61.70	0.751	0.782	0.821
64.20	0.669	0.708	0.747
69.20	0.478	0.513	0.567
71.70	0.613	0.645	0.686
74.20	0.391	0.449	0.510
76.70	0.481	0.526	0.578
79.20	0.528	0.567	0.634
81.70	0.400	0.470	0.532
84.20	0.532	0.586	0.616
86.70	0.471	0.524	0.593
89.20	0.550	0.635	0.682
91.70	0.547	0.623	0.701
94.20	0.570	0.663	0.715
96.70	0.688	0.760	0.814
99.20	0.717	0.763	0.812
101.70	0.777	0.838	0.878
104.20	0.803	0.854	0.883
106.70	0.869	0.898	0.921
109.20	0.899	0.923	0.946
111.70	0.917	0.946	0.968
114.20	0.924	0.958	0.975
116.70	0.938	0.968	0.988
119.20	0.957	0.979	0.988
121.70	0.980	0.989	0.996
124.20	0.981	0.992	0.997
126.70	0.990	0.994	0.999
131.70	0.994	0.997	1.000
136.70	0.996	0.999	1.000
141.70	0.998	1.000	1.000
146.70	0.999	1.000	1.000

Step 2 $q_w = 0.150m^2/s$	$x = 400mm, y = 248mm$		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.362	0.448	0.501
2.70	0.334	0.396	0.464
3.70	0.540	0.596	0.654
4.70	0.615	0.652	0.735
5.70	0.651	0.711	0.746
6.70	0.794	0.824	0.854
7.70	0.692	0.727	0.753
8.70	0.788	0.808	0.843
9.70	0.831	0.855	0.880
10.70	0.713	0.736	0.767
11.70	0.797	0.832	0.857
13.70	0.666	0.705	0.747
15.70	0.560	0.613	0.644
17.70	0.735	0.759	0.794
19.70	0.646	0.679	0.708
21.70	0.601	0.648	0.681
23.70	0.535	0.572	0.605
25.70	0.659	0.696	0.731
27.70	0.557	0.603	0.690
29.70	0.464	0.504	0.564
31.70	0.595	0.660	0.700
33.70	0.645	0.694	0.738
35.70	0.541	0.598	0.631
37.70	0.502	0.551	0.601
39.70	0.593	0.657	0.713
41.70	0.662	0.716	0.769
43.70	0.543	0.641	0.691
45.70	0.544	0.601	0.652
47.70	0.706	0.761	0.810
49.70	0.723	0.768	0.806
51.70	0.645	0.730	0.791
53.70	0.645	0.705	0.776
55.70	0.738	0.813	0.869
57.70	0.742	0.815	0.869
59.70	0.714	0.777	0.852
61.70	0.765	0.832	0.885

63.70	0.832	0.874	0.915
65.70	0.829	0.878	0.927
68.70	0.876	0.898	0.944
71.70	0.871	0.923	0.950
74.70	0.903	0.937	0.956
77.70	0.898	0.941	0.965
81.70	0.939	0.960	0.974
86.70	0.956	0.975	0.987
91.70	0.974	0.985	0.992
101.70	0.989	0.994	0.998
111.70	0.996	0.999	1.000
121.70	0.998	1.000	1.000
131.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$	x = 500mm, y = 248mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.135	0.157	0.196
3.70	0.138	0.178	0.238
4.20	0.142	0.171	0.236
4.70	0.214	0.277	0.335
5.70	0.249	0.284	0.326
6.70	0.326	0.377	0.416
7.70	0.427	0.468	0.522
8.70	0.431	0.493	0.536
9.70	0.553	0.599	0.645
10.70	0.590	0.626	0.672
11.70	0.656	0.686	0.736
12.70	0.705	0.746	0.792
13.70	0.669	0.732	0.767
14.70	0.759	0.791	0.815
15.70	0.799	0.825	0.849
17.70	0.817	0.859	0.885
19.70	0.840	0.875	0.897
21.70	0.868	0.895	0.918
23.70	0.920	0.937	0.957
25.70	0.920	0.935	0.951
27.70	0.919	0.941	0.960
29.70	0.935	0.951	0.968
31.70	0.945	0.965	0.980
33.70	0.945	0.966	0.980
35.70	0.911	0.957	0.976
37.70	0.957	0.973	0.983
39.70	0.966	0.977	0.984
41.70	0.959	0.976	0.959
44.70	0.969	0.982	0.990
47.70	0.973	0.982	0.992
51.70	0.975	0.985	0.992
56.70	0.975	0.989	0.993
61.70	0.983	0.990	0.995
66.70	0.989	0.993	0.997
71.70	0.991	0.996	0.999
81.70	0.995	0.998	1.000
91.70	0.998	0.999	1.000
101.70	0.999	1.000	1.000
111.70	1.000	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$	x = 600mm, y = 248mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.060	0.084	0.109
2.70	0.052	0.071	0.099
3.70	0.041	0.065	0.085
4.70	0.109	0.142	0.184
5.70	0.155	0.189	0.231
6.70	0.172	0.212	0.273
7.70	0.239	0.279	0.309
8.70	0.257	0.288	0.338
9.70	0.270	0.315	0.355
10.70	0.307	0.363	0.424
11.70	0.303	0.352	0.398
12.70	0.354	0.409	0.510
13.70	0.398	0.444	0.510
14.70	0.360	0.422	0.496
15.70	0.447	0.502	0.581
16.70	0.454	0.508	0.568
17.70	0.460	0.518	0.587
18.70	0.526	0.565	0.648
19.70	0.479	0.539	0.606
20.70	0.546	0.598	0.658
21.70	0.622	0.663	0.722
22.70	0.536	0.606	0.672
23.70	0.650	0.699	0.756
24.70	0.626	0.697	0.774
25.70	0.661	0.715	0.814
26.70	0.708	0.760	0.820
27.70	0.670	0.734	0.786
28.70	0.708	0.769	0.839

29.70	0.786	0.822	0.872
30.70	0.723	0.772	0.871
31.70	0.807	0.853	0.898
32.70	0.823	0.871	0.940
33.70	0.787	0.845	0.876
34.70	0.868	0.907	0.941
35.70	0.843	0.893	0.934
36.70	0.834	0.883	0.919
37.70	0.906	0.930	0.950
38.70	0.855	0.892	0.932
39.70	0.900	0.946	0.973
40.70	0.940	0.956	0.975
41.70	0.892	0.931	0.956
42.70	0.952	0.968	0.984
43.70	0.931	0.960	0.974
45.70	0.971	0.981	0.989
47.70	0.968	0.982	0.993
50.70	0.985	0.992	0.996
55.70	0.992	0.996	0.999
61.70	0.994	0.999	1.000
71.70	0.996	0.999	1.000
81.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ x = 800mm, y = 248mm

z [mm]	C (5s of 180s) Min	Mean	Max
1.70	0.000	0.001	0.003
3.70	0.007	0.010	0.015
5.70	0.016	0.023	0.030
7.70	0.026	0.033	0.046
9.70	0.023	0.037	0.055
11.70	0.037	0.051	0.066
13.70	0.045	0.060	0.073
15.70	0.045	0.056	0.071
17.70	0.049	0.061	0.071
19.70	0.059	0.074	0.087
21.70	0.069	0.083	0.102
23.70	0.066	0.075	0.087
25.70	0.078	0.096	0.115
27.70	0.088	0.108	0.125
29.70	0.093	0.118	0.135
31.70	0.099	0.108	0.129
33.70	0.120	0.137	0.155
35.70	0.134	0.152	0.170
37.70	0.133	0.161	0.187
39.70	0.125	0.143	0.171
41.70	0.150	0.173	0.192
43.70	0.150	0.173	0.193
45.70	0.137	0.160	0.185
47.70	0.105	0.134	0.160
49.70	0.137	0.168	0.196
51.70	0.143	0.186	0.225
53.70	0.129	0.178	0.209
55.70	0.168	0.206	0.262
57.70	0.247	0.301	0.348
59.70	0.332	0.410	0.488
61.70	0.331	0.429	0.532
63.70	0.409	0.538	0.650
65.70	0.523	0.635	0.730
67.70	0.653	0.736	0.820
69.70	0.662	0.762	0.835
71.70	0.754	0.824	0.896
73.70	0.830	0.894	0.941
75.70	0.865	0.928	0.963
77.70	0.860	0.920	0.956
79.70	0.846	0.948	0.976
81.70	0.965	0.982	0.997
83.70	0.966	0.984	0.994
85.70	0.937	0.973	0.993
87.70	0.969	0.988	0.997
90.70	0.980	0.991	0.998
93.70	0.984	0.995	0.999
97.70	0.996	0.999	1.000
101.70	0.996	0.999	1.000
106.70	0.998	1.000	1.000
116.70	0.999	1.000	1.000

Step 2 $q_w = 0.150 m^2/s$ x = 1000mm, y = 248mm

z [mm]	C (5s of 180s) Min	Mean	Max
1.70	0.000	0.000	0.000
4.70	0.000	0.001	0.001
7.70	0.002	0.003	0.004
10.70	0.003	0.004	0.007
13.70	0.004	0.006	0.008
16.70	0.005	0.007	0.009
19.70	0.006	0.008	0.011
22.70	0.007	0.009	0.012

25.70	0.007	0.010	0.014
28.70	0.008	0.012	0.017
31.70	0.012	0.015	0.019
34.70	0.012	0.016	0.021
37.70	0.016	0.020	0.026
40.70	0.016	0.021	0.027
43.70	0.019	0.026	0.033
46.70	0.023	0.029	0.040
49.70	0.018	0.026	0.037
52.70	0.019	0.026	0.046
55.70	0.020	0.031	0.046
58.70	0.026	0.037	0.053
61.70	0.030	0.046	0.071
64.70	0.045	0.057	0.081
67.70	0.053	0.078	0.106
69.70	0.048	0.098	0.155
71.70	0.058	0.118	0.212
72.70	0.122	0.178	0.257
73.70	0.128	0.216	0.318
75.70	0.140	0.274	0.407
77.70	0.192	0.342	0.501
78.70	0.236	0.414	0.578
79.70	0.192	0.449	0.578
80.70	0.364	0.545	0.689
81.70	0.360	0.575	0.708
82.70	0.380	0.589	0.728
83.70	0.491	0.682	0.807
84.70	0.579	0.731	0.843
85.70	0.555	0.755	0.845
86.70	0.672	0.798	0.901
87.70	0.713	0.800	0.881
88.70	0.742	0.849	0.932
89.70	0.746	0.862	0.928
90.70	0.758	0.870	0.929
91.70	0.818	0.901	0.965
93.70	0.877	0.938	0.967
96.70	0.918	0.961	0.985
100.70	0.934	0.980	0.997
105.70	0.984	0.994	0.999
111.70	0.993	0.998	1.000
119.70	0.993	0.999	1.000
131.70	0.999	1.000	1.000

Step 2 $q_w = 0.150$m²/s	x = 1200mm, y = 248mm		
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
3.70	0.000	0.001	0.001
5.70	0.002	0.002	0.003
7.70	0.003	0.004	0.005
9.70	0.004	0.005	0.006
11.70	0.005	0.007	0.010
13.70	0.006	0.008	0.010
15.70	0.006	0.008	0.011
17.70	0.005	0.007	0.010
19.70	0.007	0.010	0.012
21.70	0.009	0.011	0.014
23.70	0.008	0.010	0.012
25.70	0.007	0.010	0.012
27.70	0.008	0.011	0.015
29.70	0.008	0.011	0.016
31.70	0.006	0.009	0.012
33.70	0.006	0.010	0.014
35.70	0.007	0.010	0.013
37.70	0.007	0.010	0.013
39.70	0.004	0.007	0.011
41.70	0.006	0.009	0.012
43.70	0.006	0.010	0.015
45.70	0.007	0.010	0.014
47.70	0.004	0.009	0.016
49.70	0.008	0.015	0.028
51.70	0.015	0.026	0.041
53.70	0.021	0.035	0.052
55.70	0.030	0.052	0.087
57.70	0.062	0.095	0.135
59.70	0.092	0.128	0.164
61.70	0.149	0.208	0.293
63.70	0.194	0.266	0.334
65.70	0.267	0.372	0.473
67.70	0.364	0.453	0.582
69.70	0.356	0.518	0.616
71.70	0.464	0.612	0.711
73.70	0.643	0.728	0.795
75.70	0.724	0.792	0.864
77.70	0.722	0.808	0.870
79.70	0.805	0.886	0.952
81.70	0.863	0.920	0.962
83.70	0.919	0.946	0.974

85.70	0.894	0.943	0.971
88.70	0.935	0.974	0.990
91.70	0.972	0.987	0.999
95.70	0.983	0.995	1.000
101.70	0.992	0.997	1.000
111.70	0.999	1.000	1.000
121.70	1.000	1.000	1.000

Step 2 q_w = 0.150m²/s x = 1400mm, y = 248mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
5.70	0.001	0.001	0.002
9.70	0.002	0.004	0.005
13.70	0.003	0.005	0.007
17.70	0.004	0.006	0.008
21.70	0.002	0.005	0.007
25.70	0.003	0.005	0.007
29.70	0.003	0.005	0.007
31.70	0.007	0.011	0.016
33.70	0.008	0.016	0.034
35.70	0.008	0.018	0.041
37.70	0.029	0.060	0.092
39.70	0.052	0.106	0.166
41.70	0.102	0.155	0.222
43.70	0.160	0.221	0.284
44.70	0.257	0.335	0.405
45.70	0.340	0.432	0.514
46.70	0.344	0.451	0.545
47.70	0.474	0.581	0.688
48.70	0.495	0.616	0.693
49.70	0.612	0.678	0.761
50.70	0.688	0.779	0.833
51.70	0.706	0.762	0.821
52.70	0.787	0.832	0.866
53.70	0.860	0.900	0.940
54.70	0.848	0.891	0.928
55.70	0.903	0.942	0.974
56.70	0.928	0.957	0.978
57.70	0.922	0.951	0.971
59.70	0.939	0.972	0.987
61.70	0.983	0.991	0.997
64.70	0.992	0.997	0.999
67.70	0.993	0.998	1.000

71.70	0.996	0.998	1.000
76.70	0.997	0.999	1.000
83.70	0.997	0.999	1.000
91.70	0.998	1.000	1.000
101.70	0.999	1.000	1.000
131.70	0.999	1.000	1.000

Step 2 q_w = 0.150m²/s x = 1600mm, y = 248mm			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.001
7.70	0.000	0.002	0.003
13.70	0.002	0.004	0.007
17.70	0.002	0.004	0.007
21.70	0.004	0.007	0.009
25.70	0.005	0.009	0.015
27.70	0.008	0.018	0.032
29.70	0.016	0.034	0.067
31.70	0.031	0.055	0.083
33.70	0.063	0.106	0.141
34.70	0.119	0.169	0.219
35.70	0.158	0.223	0.303
36.70	0.198	0.261	0.324
37.70	0.263	0.361	0.427
38.70	0.309	0.405	0.503
39.70	0.386	0.453	0.511
40.70	0.513	0.590	0.668
41.70	0.559	0.622	0.703
42.70	0.664	0.720	0.780
43.70	0.734	0.787	0.829
44.70	0.732	0.794	0.833
45.70	0.827	0.870	0.855
46.70	0.869	0.901	0.929
47.70	0.879	0.908	0.942
49.70	0.921	0.950	0.973
51.70	0.974	0.987	0.996
54.70	0.985	0.994	0.999
57.70	0.994	0.997	1.000
61.70	0.995	0.999	1.000
65.70	0.998	0.999	1.000
71.70	0.998	0.999	1.000
81.70	0.999	1.000	1.000
91.70	0.999	1.000	1.000
101.70	0.999	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 1800\text{mm}, y = 248\text{mm}$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
9.70	0.000	0.001	0.002
15.70	0.002	0.003	0.005
19.70	0.002	0.004	0.006
21.70	0.004	0.009	0.015
23.70	0.010	0.018	0.032
25.70	0.017	0.029	0.055
26.70	0.043	0.066	0.099
27.70	0.042	0.101	0.140
28.70	0.075	0.117	0.164
29.70	0.121	0.198	0.268
30.70	0.150	0.210	0.264
31.70	0.242	0.315	0.386
32.70	0.340	0.408	0.464
33.70	0.330	0.418	0.485
34.70	0.465	0.553	0.630
35.70	0.522	0.622	0.679
36.70	0.573	0.648	0.736
37.70	0.685	0.765	0.815
38.70	0.691	0.771	0.823
39.70	0.755	0.820	0.870
40.70	0.840	0.893	0.946
41.70	0.865	0.899	0.939
42.70	0.901	0.939	0.962
43.70	0.925	0.960	0.977
44.70	0.928	0.958	0.975
45.70	0.962	0.980	0.994
47.70	0.970	0.984	0.994
49.70	0.981	0.992	0.999
51.70	0.990	0.998	1.000
54.70	0.995	0.999	1.000
57.70	0.995	0.998	1.000
61.70	0.998	0.999	1.000
66.70	0.997	0.999	1.000
73.70	0.999	1.000	1.000
81.70	0.999	1.000	1.000
91.70	0.999	1.000	1.000
101.70	0.999	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 2000\text{mm}, y = 248\text{mm}$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
7.70	0.000	0.002	0.003
11.70	0.002	0.003	0.005
15.70	0.003	0.006	0.009
16.70	0.005	0.007	0.010
17.70	0.004	0.005	0.010
19.70	0.006	0.010	0.012
21.70	0.011	0.018	0.026
23.70	0.020	0.038	0.051
25.70	0.041	0.072	0.108
26.70	0.077	0.109	0.157
27.70	0.114	0.149	0.220
28.70	0.166	0.202	0.247
29.70	0.223	0.283	0.379
30.70	0.265	0.332	0.405
31.70	0.329	0.398	0.463
32.70	0.405	0.471	0.527
33.70	0.488	0.537	0.646
34.70	0.520	0.607	0.657
35.70	0.581	0.671	0.756
36.70	0.628	0.716	0.806
37.70	0.697	0.788	0.839
38.70	0.760	0.827	0.885
39.70	0.802	0.857	0.903
40.70	0.839	0.887	0.928
41.70	0.847	0.916	0.953
42.70	0.896	0.935	0.978
43.70	0.905	0.952	0.976
45.70	0.947	0.975	0.991
47.70	0.972	0.986	0.997
50.70	0.990	0.997	1.000
53.70	0.993	0.999	1.000
57.70	0.998	1.000	1.000
61.70	1.000	1.000	1.000

Step 2 $q_w = 0.150\text{m}^2/\text{s}$ $x = 2200\text{mm}, y = 248\text{mm}$			
z	C (5s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
9.70	0.000	0.001	0.003
13.70	0.001	0.004	0.006

17.70	0.003	0.005	0.007
21.70	0.010	0.015	0.025
23.70	0.017	0.029	0.059
25.70	0.035	0.064	0.093
27.70	0.081	0.136	0.211
29.70	0.173	0.243	0.302
30.70	0.220	0.303	0.374
31.70	0.247	0.356	0.475
32.70	0.332	0.411	0.473
33.70	0.352	0.467	0.558
34.70	0.434	0.576	0.732
35.70	0.532	0.648	0.715
36.70	0.546	0.680	0.780
37.70	0.642	0.738	0.799
38.70	0.680	0.772	0.850
39.70	0.738	0.819	0.886
40.70	0.811	0.859	0.916
41.70	0.826	0.881	0.935
42.70	0.840	0.909	0.966
43.70	0.883	0.940	0.968
45.70	0.923	0.966	0.991
47.70	0.925	0.979	0.999
50.70	0.974	0.993	0.999
53.70	0.995	0.999	1.000
57.70	0.998	1.000	1.000
61.70	0.998	1.000	1.000

Step 2 $q_w = 0.150$m²/s		$x = 2400$mm, $y = 248$mm	
z	C (5s of 180s)		
[mm]	Min	Mean	Max
0.75	0.000	0.000	0.000
10.75	0.000	0.001	0.001
16.75	0.001	0.002	0.003
22.75	0.001	0.003	0.007
24.75	0.005	0.008	0.016
26.75	0.006	0.015	0.026
28.75	0.015	0.031	0.053
30.75	0.034	0.061	0.088
32.75	0.071	0.119	0.193
33.75	0.092	0.147	0.209
34.75	0.114	0.187	0.254
35.75	0.154	0.230	0.281
36.75	0.199	0.292	0.470
37.75	0.244	0.344	0.475
38.75	0.288	0.392	0.529
39.75	0.330	0.438	0.538
40.75	0.394	0.482	0.586
41.75	0.431	0.554	0.671
42.75	0.464	0.612	0.729
43.75	0.577	0.668	0.790
44.75	0.606	0.716	0.820
45.75	0.646	0.752	0.850
46.75	0.695	0.787	0.888
47.75	0.730	0.828	0.910
48.75	0.801	0.863	0.919
49.75	0.809	0.892	0.952
50.75	0.806	0.911	0.964
52.75	0.856	0.943	0.984
54.75	0.940	0.967	0.988
57.75	0.925	0.984	0.998
60.75	0.985	0.994	1.000
64.75	0.995	0.999	1.000
68.75	0.997	1.000	1.000
72.75	0.998	1.000	1.000
76.75	1.000	1.000	1.000

Table H-6 Single-tip conductivity probe data: Experiment ST4 (Step 9, $q_w = 0.150$m²/s, $Y = 0$)

Step 9 $q_w = 0.150$m²/s		$x = 0$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
0.75	0.000	0.000	0.000
25.75	0.001	0.001	0.001
28.75	0.001	0.001	0.002
30.75	0.001	0.001	0.005
32.75	0.002	0.004	0.010
34.75	0.004	0.011	0.020
36.75	0.018	0.029	0.050
38.75	0.032	0.057	0.082
40.75	0.088	0.117	0.146
41.75	0.125	0.154	0.183

42.75	0.143	0.185	0.228
43.75	0.188	0.234	0.280
44.75	0.253	0.300	0.348
45.75	0.295	0.344	0.393
46.75	0.358	0.403	0.448
47.75	0.398	0.462	0.526
48.75	0.440	0.508	0.576
49.75	0.521	0.579	0.638
50.75	0.578	0.624	0.671
51.75	0.636	0.678	0.721
52.75	0.671	0.724	0.778
53.75	0.711	0.756	0.801
54.75	0.763	0.802	0.841
55.75	0.801	0.835	0.868
56.75	0.816	0.857	0.898
57.75	0.858	0.886	0.913
58.75	0.882	0.910	0.938
59.75	0.897	0.921	0.945
60.75	0.916	0.934	0.951
62.75	0.942	0.957	0.971
64.75	0.960	0.972	0.985
66.75	0.977	0.983	0.989
68.75	0.979	0.988	0.994
70.75	0.988	0.995	0.997
72.75	0.992	0.997	0.999
74.75	0.996	0.998	0.999
76.75	0.997	0.999	0.999

Step 9 $q_w = 0.150 m^2/s$		$x = 20 mm$, $y = 0 mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
31.70	0.000	0.000	0.001
41.70	0.000	0.000	0.001
51.70	0.001	0.001	0.001
61.70	0.001	0.001	0.002
71.70	0.001	0.002	0.003
81.70	0.001	0.002	0.003
91.70	0.001	0.002	0.004
96.70	0.001	0.003	0.005
101.70	0.001	0.003	0.005
106.70	0.001	0.003	0.006
117.70	0.001	0.004	0.017
119.70	0.001	0.004	0.010
121.70	0.002	0.004	0.006
123.70	0.003	0.007	0.017
127.70	0.002	0.006	0.010
129.70	0.003	0.005	0.007
131.70	0.001	0.003	0.004
134.70	0.000	0.000	0.000
161.70	0.000	0.000	0.000
163.70	0.001	0.001	0.002
165.70	0.001	0.003	0.009
167.70	0.003	0.006	0.016
169.70	0.011	0.023	0.035
171.70	0.020	0.044	0.068
173.70	0.056	0.078	0.100
175.70	0.105	0.138	0.170
177.70	0.173	0.213	0.253
179.70	0.253	0.304	0.355
181.70	0.323	0.378	0.433
183.70	0.460	0.494	0.528
185.70	0.535	0.594	0.653
187.70	0.620	0.664	0.708
189.70	0.715	0.756	0.798
191.70	0.743	0.796	0.850
193.70	0.818	0.850	0.883
195.70	0.874	0.902	0.930
198.70	0.910	0.934	0.959
201.70	0.952	0.969	0.985
206.70	0.972	0.984	0.997
211.70	0.988	0.993	0.997

Step 9 $q_w = 0.150 m^2/s$		$x = 100 mm$, $y = 0 mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
11.70	0.001	0.001	0.002
16.70	0.001	0.002	0.004
26.70	0.002	0.004	0.007
36.70	0.003	0.007	0.011
51.70	0.005	0.010	0.015
66.70	0.006	0.011	0.017
81.70	0.009	0.015	0.020
96.70	0.009	0.015	0.021
106.70	0.007	0.011	0.015
111.70	0.006	0.009	0.012
116.70	0.004	0.006	0.009

121.70	0.002	0.003	0.004
126.70	0.001	0.001	0.002
128.20	0.001	0.001	0.001
135.70	0.001	0.001	0.001
141.70	0.001	0.002	0.005
146.70	0.003	0.005	0.015
149.70	0.007	0.016	0.024
151.70	0.018	0.029	0.040
153.70	0.031	0.044	0.057
155.70	0.042	0.060	0.078
157.70	0.087	0.100	0.113
159.70	0.102	0.131	0.160
161.70	0.153	0.187	0.221
163.70	0.203	0.243	0.283
165.70	0.251	0.298	0.346
167.70	0.331	0.375	0.419
169.70	0.411	0.450	0.489
171.70	0.474	0.510	0.546
173.70	0.539	0.588	0.637
175.70	0.617	0.652	0.687
177.70	0.682	0.721	0.759
179.70	0.737	0.776	0.815
181.70	0.784	0.818	0.852
183.70	0.810	0.838	0.867
185.70	0.860	0.880	0.900
187.70	0.881	0.905	0.929
189.70	0.901	0.922	0.942
191.70	0.927	0.943	0.959
193.70	0.941	0.958	0.975
195.70	0.953	0.966	0.979
198.70	0.967	0.977	0.987
201.70	0.969	0.983	0.990
206.70	0.988	0.995	0.998
211.70	0.997	0.999	1.000

Step 9 $q_w = 0.150$m²/s		$x = 200$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
11.70	0.001	0.001	0.002
21.70	0.002	0.004	0.008
31.70	0.004	0.010	0.019
36.70	0.005	0.013	0.028
41.70	0.006	0.016	0.032
46.70	0.012	0.023	0.038
51.70	0.014	0.023	0.037
61.70	0.013	0.020	0.036
71.70	0.010	0.018	0.034
81.70	0.008	0.011	0.018
91.70	0.008	0.014	0.020
96.70	0.011	0.018	0.026
101.70	0.022	0.031	0.040
106.70	0.046	0.062	0.078
109.70	0.052	0.076	0.101
111.70	0.069	0.094	0.119
113.70	0.091	0.117	0.144
115.70	0.103	0.136	0.170
117.70	0.143	0.173	0.203
119.70	0.163	0.206	0.250
121.70	0.198	0.238	0.278
123.70	0.243	0.286	0.330
125.70	0.250	0.306	0.363
127.70	0.315	0.358	0.400
129.70	0.343	0.391	0.440
131.70	0.415	0.451	0.488
133.70	0.468	0.509	0.550
135.70	0.490	0.538	0.585
137.70	0.550	0.591	0.633
139.70	0.575	0.625	0.675
141.70	0.615	0.655	0.695
143.70	0.638	0.688	0.738
145.70	0.700	0.743	0.785
147.70	0.740	0.778	0.815
149.70	0.753	0.794	0.835
151.70	0.793	0.821	0.850
154.70	0.820	0.850	0.880
157.70	0.850	0.879	0.908
161.70	0.897	0.912	0.928
166.70	0.914	0.932	0.949
171.70	0.944	0.957	0.969
176.70	0.966	0.974	0.983
181.70	0.975	0.983	0.991
186.70	0.984	0.989	0.995
191.70	0.989	0.993	0.996
196.70	0.991	0.997	0.998
201.70	0.996	0.999	1.000
206.70	0.998	0.999	1.000

Step 9 q_w = 0.150m²/s		x = 300mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.002
6.70	0.001	0.002	0.004
11.70	0.003	0.005	0.008
16.70	0.004	0.007	0.013
26.70	0.006	0.011	0.015
36.70	0.008	0.014	0.020
41.70	0.010	0.018	0.027
46.70	0.019	0.029	0.039
51.70	0.023	0.038	0.053
56.70	0.053	0.067	0.082
59.70	0.068	0.095	0.122
61.70	0.082	0.110	0.139
63.70	0.109	0.135	0.160
65.70	0.143	0.168	0.193
67.70	0.148	0.190	0.233
69.70	0.195	0.235	0.275
71.70	0.225	0.270	0.315
73.70	0.255	0.306	0.358
75.70	0.298	0.358	0.418
77.70	0.345	0.391	0.438
79.70	0.395	0.443	0.490
81.70	0.430	0.489	0.548
83.70	0.460	0.525	0.590
85.70	0.515	0.565	0.615
87.70	0.568	0.613	0.658
89.70	0.598	0.638	0.678
91.70	0.635	0.679	0.723
93.70	0.670	0.714	0.758
95.70	0.700	0.746	0.793
97.70	0.733	0.774	0.815
99.70	0.748	0.786	0.825
101.70	0.770	0.805	0.840
105.70	0.825	0.846	0.868
109.70	0.855	0.879	0.903
113.70	0.878	0.898	0.918
117.70	0.897	0.915	0.933
121.70	0.912	0.930	0.947
126.70	0.929	0.946	0.963
131.70	0.946	0.957	0.969
136.70	0.956	0.967	0.979
141.70	0.964	0.975	0.986
146.70	0.969	0.980	0.990
151.70	0.984	0.989	0.993
156.70	0.988	0.992	0.996
161.70	0.990	0.994	0.997
166.70	0.992	0.995	0.997
171.70	0.994	0.996	0.999
176.70	0.995	0.998	1.000
181.70	0.997	0.999	1.000

Step 9 q_w = 0.150m²/s		x = 400mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.002
6.70	0.001	0.001	0.003
11.70	0.003	0.004	0.007
16.70	0.004	0.006	0.012
26.70	0.005	0.007	0.013
36.70	0.007	0.013	0.023
41.70	0.015	0.024	0.033
46.70	0.037	0.053	0.069
49.70	0.069	0.087	0.105
51.70	0.091	0.117	0.143
53.70	0.115	0.143	0.170
55.70	0.160	0.190	0.221
57.70	0.203	0.239	0.276
59.70	0.256	0.289	0.323
61.70	0.296	0.338	0.381
63.70	0.378	0.415	0.451
65.70	0.431	0.476	0.521
67.70	0.476	0.521	0.566
69.70	0.544	0.576	0.609
71.70	0.607	0.639	0.672
73.70	0.654	0.684	0.714
75.70	0.697	0.728	0.759
77.70	0.714	0.757	0.799
79.70	0.754	0.784	0.815
81.70	0.782	0.811	0.840
83.70	0.827	0.852	0.877
85.70	0.852	0.873	0.895
87.70	0.873	0.893	0.912
89.70	0.884	0.906	0.928
91.70	0.901	0.917	0.934
93.70	0.917	0.932	0.948
96.70	0.924	0.941	0.958
101.70	0.953	0.963	0.973

106.70	0.963	0.973	0.982
111.70	0.973	0.982	0.991
116.70	0.981	0.987	0.993
121.70	0.984	0.989	0.994
131.70	0.991	0.995	0.998
141.70	0.994	0.997	0.999
151.70	0.996	0.999	1.000
161.70	0.999	1.000	1.000

Step 9 q_w = 0.150m²/s		x = 500mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.001	0.002
11.70	0.002	0.004	0.007
16.70	0.004	0.006	0.011
26.70	0.010	0.016	0.026
36.70	0.036	0.053	0.070
41.70	0.084	0.107	0.131
44.70	0.106	0.134	0.162
47.70	0.135	0.179	0.222
49.70	0.190	0.222	0.255
51.70	0.230	0.269	0.307
53.70	0.280	0.321	0.362
55.70	0.310	0.350	0.390
57.70	0.350	0.392	0.435
59.70	0.385	0.430	0.475
61.70	0.420	0.463	0.507
63.70	0.480	0.515	0.550
65.70	0.505	0.537	0.570
67.70	0.535	0.572	0.610
69.70	0.572	0.613	0.655
71.70	0.612	0.651	0.689
73.70	0.650	0.682	0.714
75.70	0.662	0.688	0.714
78.70	0.699	0.728	0.757
81.70	0.739	0.764	0.789
84.70	0.772	0.798	0.824
87.70	0.799	0.823	0.847
91.70	0.824	0.847	0.869
95.70	0.857	0.879	0.902
99.70	0.872	0.895	0.917
105.70	0.902	0.915	0.927
111.70	0.932	0.945	0.958

121.70	0.961	0.970	0.980
131.70	0.977	0.983	0.990
141.70	0.989	0.992	0.995
151.70	0.990	0.996	0.998
161.70	0.997	0.998	0.999
171.70	0.998	0.999	1.000
181.70	0.999	1.000	1.000

Step 9 q_w = 0.150m²/s		x = 600mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.002	0.004
11.70	0.005	0.007	0.010
16.70	0.009	0.014	0.020
21.70	0.021	0.029	0.038
26.70	0.031	0.051	0.071
31.70	0.098	0.102	0.107
36.70	0.118	0.148	0.178
41.70	0.170	0.215	0.260
46.70	0.245	0.287	0.328
49.20	0.290	0.344	0.398
51.70	0.340	0.382	0.423
54.20	0.375	0.422	0.468
56.70	0.403	0.451	0.498
59.20	0.446	0.493	0.541
61.70	0.506	0.538	0.571
64.20	0.531	0.576	0.621
66.70	0.556	0.601	0.646
69.20	0.603	0.640	0.676
71.70	0.638	0.670	0.701
74.20	0.671	0.705	0.738
76.70	0.686	0.718	0.751
79.20	0.721	0.745	0.768
81.70	0.751	0.772	0.793
84.20	0.781	0.800	0.819
86.70	0.791	0.819	0.846
89.20	0.804	0.830	0.856
91.70	0.821	0.847	0.874
94.20	0.839	0.865	0.891
96.70	0.859	0.882	0.906
99.20	0.871	0.891	0.910
101.70	0.880	0.898	0.916
106.70	0.901	0.918	0.935

111.70	0.919	0.934	0.949
116.70	0.939	0.951	0.963
121.70	0.948	0.960	0.971
131.70	0.972	0.978	0.984
141.70	0.982	0.987	0.992
151.70	0.988	0.992	0.996
161.70	0.994	0.996	0.999
171.70	0.981	0.999	1.000
181.70	0.997	0.999	1.000
191.70	0.999	1.000	1.000

Step 9 $q_w = 0.150 m^2/s$		$x = 800mm$, $y = 0mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.003	0.004	0.006
11.70	0.008	0.012	0.016
16.70	0.018	0.027	0.037
21.70	0.035	0.054	0.073
26.70	0.055	0.078	0.102
31.70	0.082	0.105	0.128
36.70	0.140	0.164	0.188
41.70	0.175	0.215	0.255
46.70	0.260	0.304	0.348
49.20	0.303	0.342	0.380
51.70	0.328	0.373	0.418
54.20	0.370	0.408	0.446
56.70	0.390	0.436	0.481
59.20	0.443	0.482	0.521
61.70	0.493	0.534	0.576
64.20	0.526	0.564	0.603
66.70	0.561	0.597	0.633
69.20	0.601	0.640	0.678
71.70	0.633	0.671	0.708
74.20	0.666	0.710	0.753
76.70	0.686	0.726	0.766
79.20	0.721	0.757	0.793
81.70	0.753	0.783	0.814
84.20	0.773	0.801	0.829
86.70	0.786	0.822	0.859
91.70	0.816	0.848	0.881
96.70	0.857	0.884	0.912
101.70	0.880	0.905	0.930
106.70	0.913	0.927	0.941

111.70	0.927	0.941	0.956
121.70	0.953	0.963	0.972
131.70	0.969	0.977	0.985
141.70	0.976	0.983	0.990
151.70	0.987	0.992	0.996
161.70	0.991	0.995	0.997
171.70	0.993	0.998	0.999
181.70	0.996	0.999	1.000
191.70	0.998	0.999	1.000

Step 9 $q_w = 0.150 m^2/s$		$x = 1000mm$, $y = 0mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.002	0.003
11.70	0.004	0.005	0.006
16.70	0.006	0.009	0.012
21.70	0.011	0.014	0.017
26.70	0.015	0.018	0.022
31.70	0.025	0.032	0.040
36.70	0.038	0.057	0.076
41.70	0.071	0.095	0.120
45.70	0.128	0.171	0.215
49.70	0.203	0.248	0.293
51.70	0.243	0.286	0.330
53.70	0.298	0.343	0.388
55.70	0.340	0.393	0.445
57.70	0.398	0.443	0.488
59.70	0.455	0.500	0.545
61.70	0.535	0.575	0.615
63.70	0.583	0.636	0.690
65.70	0.638	0.686	0.735
67.70	0.698	0.736	0.775
69.70	0.725	0.765	0.805
71.70	0.773	0.803	0.833
73.70	0.808	0.844	0.880
75.70	0.843	0.870	0.898
77.70	0.865	0.890	0.915
79.70	0.884	0.910	0.936
81.70	0.911	0.932	0.953
84.70	0.932	0.946	0.961
88.70	0.952	0.963	0.975
93.70	0.973	0.980	0.987
98.70	0.981	0.987	0.993

104.70	0.985	0.993	0.996
111.70	0.993	0.996	0.998
121.70	0.994	0.998	0.999
136.70	0.996	0.999	1.000
151.70	0.998	0.999	1.000
166.70	0.999	1.000	1.000

Step 9 q_w = 0.150m²/s		x = 1200mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
6.70	0.000	0.001	0.001
11.70	0.001	0.002	0.003
16.70	0.003	0.004	0.005
21.70	0.005	0.008	0.011
26.70	0.010	0.014	0.017
31.70	0.016	0.029	0.042
35.70	0.030	0.054	0.079
38.70	0.060	0.089	0.117
41.70	0.102	0.124	0.147
43.70	0.117	0.156	0.195
45.70	0.162	0.201	0.240
47.70	0.210	0.249	0.287
49.70	0.280	0.327	0.375
51.70	0.342	0.386	0.430
53.70	0.420	0.455	0.490
55.70	0.472	0.515	0.557
57.70	0.522	0.578	0.635
59.70	0.592	0.636	0.680
61.70	0.660	0.696	0.732
63.70	0.710	0.752	0.795
65.70	0.760	0.790	0.820
67.70	0.802	0.832	0.862
69.70	0.832	0.862	0.892
71.70	0.862	0.888	0.915
73.70	0.881	0.907	0.934
75.70	0.900	0.923	0.945
77.70	0.927	0.946	0.966
80.70	0.943	0.960	0.976
83.70	0.961	0.972	0.983
86.70	0.971	0.980	0.989
91.70	0.982	0.987	0.993
96.70	0.987	0.991	0.996
101.70	0.993	0.996	0.999
111.70	0.996	0.998	1.000
121.70	0.998	0.999	1.000
131.70	0.998	0.999	1.000

Step 9 q_w = 0.150m²/s		x = 1400mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.001	0.001
11.70	0.001	0.001	0.002
16.70	0.001	0.002	0.003
21.70	0.003	0.004	0.005
26.70	0.005	0.007	0.013
31.70	0.009	0.014	0.019
35.70	0.020	0.031	0.042
38.70	0.039	0.058	0.076
41.70	0.061	0.092	0.123
43.70	0.092	0.127	0.162
45.70	0.138	0.168	0.198
47.70	0.190	0.220	0.250
49.70	0.245	0.283	0.320
51.70	0.288	0.329	0.370
53.70	0.335	0.383	0.430
55.70	0.403	0.459	0.515
57.70	0.478	0.522	0.565
59.70	0.518	0.575	0.633
61.70	0.588	0.632	0.675
63.70	0.633	0.677	0.720
65.70	0.680	0.734	0.788
67.70	0.740	0.789	0.838
69.70	0.788	0.827	0.865
71.70	0.810	0.849	0.888
73.70	0.855	0.884	0.913
75.70	0.881	0.909	0.937
77.70	0.897	0.923	0.950
80.70	0.919	0.942	0.964
83.70	0.939	0.959	0.980
86.70	0.963	0.975	0.987
91.70	0.979	0.988	0.994
96.70	0.985	0.993	0.996
101.70	0.992	0.997	0.999
111.70	0.996	0.998	0.999
121.70	0.998	0.999	1.000
131.70	0.998	1.000	1.000

Step 9 $q_w = 0.150$m²/s		$x = 1800$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
18.70	0.001	0.001	0.001
20.70	0.001	0.001	0.002
26.70	0.001	0.001	0.003
31.70	0.001	0.002	0.003
36.70	0.002	0.003	0.006
41.70	0.004	0.008	0.014
44.70	0.010	0.018	0.033
47.70	0.023	0.040	0.058
49.70	0.037	0.055	0.073
51.70	0.066	0.089	0.112
53.70	0.106	0.137	0.168
55.70	0.155	0.184	0.213
57.70	0.205	0.248	0.290
58.70	0.240	0.284	0.328
59.70	0.280	0.330	0.380
60.70	0.308	0.362	0.415
61.70	0.360	0.413	0.465
62.70	0.398	0.453	0.508
63.70	0.433	0.487	0.540
64.70	0.480	0.524	0.568
65.70	0.495	0.562	0.628
66.70	0.548	0.594	0.640
67.70	0.588	0.640	0.693
68.70	0.615	0.663	0.711
69.70	0.656	0.705	0.753
70.70	0.696	0.733	0.771
71.70	0.717	0.753	0.788
73.70	0.776	0.806	0.836
75.70	0.823	0.851	0.878
77.70	0.851	0.879	0.908
79.70	0.865	0.895	0.926
81.70	0.897	0.925	0.952
83.70	0.919	0.941	0.963
86.70	0.950	0.964	0.978
91.70	0.972	0.979	0.987
96.70	0.983	0.991	0.995
101.70	0.989	0.994	0.997
106.70	0.992	0.997	0.999
111.70	0.997	0.999	1.000
116.70	0.998	0.999	1.000
121.70	0.998	0.999	1.000

Step 9 $q_w = 0.150$m²/s		$x = 2200$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
31.70	0.001	0.001	0.001
34.70	0.001	0.001	0.003
37.70	0.001	0.001	0.004
39.70	0.004	0.006	0.017
41.70	0.006	0.020	0.033
43.70	0.020	0.037	0.064
45.70	0.039	0.064	0.089
47.70	0.094	0.117	0.140
48.70	0.108	0.149	0.190
49.70	0.158	0.194	0.230
50.70	0.193	0.230	0.268
51.70	0.240	0.285	0.330
52.70	0.280	0.325	0.370
53.70	0.315	0.365	0.415
54.70	0.370	0.424	0.478
55.70	0.428	0.476	0.525
56.70	0.470	0.528	0.585
57.70	0.530	0.582	0.633
58.70	0.560	0.615	0.670
59.70	0.628	0.677	0.725
60.70	0.685	0.722	0.758
61.70	0.718	0.750	0.783
62.70	0.760	0.793	0.825
63.70	0.779	0.829	0.878
64.70	0.813	0.860	0.908
65.70	0.849	0.882	0.914
66.70	0.865	0.897	0.930
67.70	0.890	0.915	0.941
69.70	0.921	0.943	0.964
71.70	0.941	0.958	0.975
74.70	0.968	0.981	0.993
77.70	0.978	0.990	0.996
81.70	0.993	0.997	0.999
86.70	1.000	0.998	1.000
91.70	0.999	1.000	1.000

Step 9 $q_w = 0.150$m²/s		$x = 2300$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001

31.70	0.001	0.001	0.001
35.70	0.001	0.001	0.003
37.70	0.001	0.003	0.011
39.70	0.003	0.006	0.026
41.70	0.008	0.016	0.025
43.70	0.026	0.044	0.061
45.70	0.057	0.086	0.115
47.70	0.118	0.153	0.188
49.70	0.175	0.215	0.255
51.70	0.283	0.321	0.360
53.70	0.380	0.420	0.460
55.70	0.463	0.515	0.568
57.70	0.588	0.634	0.680
59.70	0.668	0.710	0.753
61.70	0.748	0.791	0.835
63.70	0.810	0.850	0.890
65.70	0.859	0.887	0.915
67.70	0.906	0.929	0.953
69.70	0.932	0.952	0.972
71.70	0.946	0.962	0.979
74.70	0.967	0.978	0.988
77.70	0.984	0.990	0.995
81.70	0.992	0.997	0.999
86.70	0.997	0.999	1.000
91.70	0.997	1.000	1.000

Step 9	q_w = 0.150m²/s		x = 2400mm, y = 0mm
z	C (30s of 180s)		
[mm]	Min	Mean	Max
0.75	0.001	0.001	0.001
28.75	0.001	0.001	0.001
30.75	0.001	0.001	0.003
32.75	0.001	0.002	0.014
34.75	0.001	0.005	0.012
36.75	0.007	0.013	0.026
38.75	0.014	0.023	0.044
40.75	0.041	0.062	0.083
42.75	0.073	0.110	0.147
43.75	0.093	0.134	0.175
44.75	0.138	0.175	0.213
45.75	0.175	0.217	0.258
46.75	0.210	0.249	0.288
47.75	0.258	0.303	0.348
48.75	0.311	0.348	0.386
49.75	0.358	0.395	0.431
50.75	0.421	0.453	0.486
51.75	0.458	0.501	0.544
52.75	0.516	0.559	0.601
53.75	0.546	0.595	0.644
54.75	0.586	0.636	0.686
55.75	0.651	0.684	0.716
56.75	0.689	0.730	0.772
57.75	0.729	0.767	0.804
58.75	0.777	0.809	0.842
59.75	0.792	0.829	0.867
60.75	0.812	0.849	0.887
61.75	0.844	0.874	0.904
62.75	0.862	0.893	0.924
63.75	0.879	0.908	0.937
64.75	0.896	0.921	0.946
66.75	0.931	0.951	0.971
68.75	0.954	0.967	0.981
70.75	0.967	0.978	0.989
73.75	0.979	0.987	0.994
76.75	0.988	0.994	0.996
80.75	0.994	0.997	0.999
85.75	0.998	0.999	1.000

Table H-7 Single-tip conductivity probe data: Experiment ST5 (Step 9, q_w = 0.130m²/s, Y = 0)

Step 9	q_w = 0.130m²/s		x = 0mm, y = 0mm
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
56.70	0.000	0.001	0.005
61.70	0.000	0.001	0.005
71.70	0.001	0.001	0.008
74.70	0.001	0.005	0.026
77.70	0.004	0.020	0.050
79.70	0.003	0.030	0.110
81.70	0.024	0.055	0.147
83.70	0.047	0.113	0.179
85.70	0.068	0.156	0.245
87.70	0.178	0.303	0.428
89.70	0.233	0.388	0.543

91.70	0.385	0.518	0.650
93.70	0.530	0.673	0.815
95.70	0.618	0.737	0.855
97.70	0.680	0.784	0.888
99.70	0.835	0.902	0.968
101.70	0.875	0.950	0.983
103.70	0.963	0.977	0.991
106.70	0.980	0.997	0.999
111.70	0.993	0.999	1.000
121.20	0.999	0.999	0.999
121.30	0.009	0.020	0.139
123.70	0.006	0.030	0.114
126.70	0.003	0.020	0.085
131.70	0.010	0.033	0.108
132.70	0.001	0.003	0.007
136.70	0.001	0.001	0.001
161.70	0.001	0.001	0.001
164.70	0.001	0.002	0.005
167.70	0.007	0.014	0.020
169.70	0.018	0.031	0.043
171.70	0.037	0.062	0.088
173.70	0.085	0.107	0.129
175.70	0.155	0.185	0.215
177.70	0.233	0.269	0.305
179.70	0.345	0.388	0.430
181.70	0.445	0.486	0.528
183.70	0.565	0.595	0.625
185.70	0.673	0.698	0.723
187.70	0.730	0.767	0.803
189.70	0.813	0.843	0.873
191.70	0.855	0.884	0.913
193.70	0.896	0.919	0.942
195.70	0.927	0.947	0.967
197.70	0.953	0.967	0.980
199.70	0.968	0.978	0.989
201.70	0.977	0.985	0.992
206.70	0.993	0.997	0.998
211.70	0.997	0.999	0.999

Step 9 $q_w = 0.130 m^2/s$		$x = 100mm$, $y = 0mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
21.70	0.001	0.001	0.003
26.70	0.001	0.002	0.006
31.70	0.001	0.003	0.006
36.70	0.002	0.003	0.008
44.20	0.002	0.004	0.007
51.70	0.002	0.004	0.009
59.20	0.004	0.006	0.010
66.70	0.004	0.007	0.010
74.20	0.004	0.007	0.013
81.70	0.004	0.007	0.012
101.70	0.004	0.007	0.014
106.70	0.005	0.008	0.016
111.70	0.004	0.006	0.018
116.70	0.002	0.004	0.013
121.70	0.001	0.002	0.005
126.70	0.000	0.000	0.001
131.70	0.000	0.001	0.003
136.70	0.001	0.002	0.004
141.70	0.004	0.006	0.009
144.70	0.008	0.014	0.021
147.70	0.016	0.029	0.042
149.70	0.018	0.037	0.057
151.70	0.042	0.060	0.079
153.70	0.068	0.093	0.118
155.70	0.116	0.144	0.172
157.70	0.153	0.183	0.213
159.70	0.210	0.259	0.308
161.70	0.255	0.306	0.358
163.70	0.368	0.401	0.435
165.70	0.425	0.460	0.495
167.70	0.513	0.546	0.580
169.70	0.585	0.623	0.660
171.70	0.640	0.675	0.710
173.70	0.703	0.738	0.773
175.70	0.748	0.784	0.820
177.70	0.798	0.834	0.870
179.70	0.835	0.863	0.890
181.70	0.870	0.897	0.925
183.70	0.900	0.915	0.930
186.70	0.924	0.944	0.964
191.70	0.954	0.970	0.985
196.70	0.975	0.983	0.992
201.70	0.990	0.994	0.998
206.70	0.995	0.998	0.999

Step 9 q_w = 0.130m²/s		x = 200mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
9.20	0.001	0.001	0.001
16.70	0.001	0.003	0.007
21.70	0.003	0.005	0.012
26.70	0.005	0.009	0.016
31.70	0.006	0.016	0.026
36.70	0.010	0.024	0.039
41.70	0.015	0.031	0.048
46.70	0.018	0.043	0.069
51.70	0.021	0.040	0.059
56.70	0.023	0.037	0.051
61.70	0.021	0.040	0.060
66.70	0.012	0.029	0.046
71.70	0.011	0.021	0.031
76.70	0.014	0.029	0.043
81.70	0.017	0.028	0.039
86.70	0.018	0.032	0.046
91.70	0.029	0.041	0.054
96.70	0.041	0.060	0.079
101.70	0.071	0.095	0.120
103.70	0.089	0.114	0.140
105.70	0.106	0.133	0.160
107.70	0.130	0.166	0.203
109.70	0.158	0.194	0.230
111.70	0.190	0.230	0.270
113.70	0.208	0.245	0.283
115.70	0.250	0.290	0.330
117.70	0.275	0.328	0.380
119.70	0.343	0.386	0.430
121.70	0.383	0.429	0.475
123.70	0.410	0.468	0.525
125.70	0.445	0.499	0.553
127.70	0.500	0.545	0.590
129.70	0.558	0.596	0.635
131.70	0.615	0.648	0.680
133.70	0.670	0.693	0.715
136.70	0.693	0.728	0.763
139.20	0.720	0.753	0.785
141.70	0.763	0.798	0.833
146.70	0.808	0.841	0.875
151.70	0.860	0.886	0.913
156.70	0.908	0.924	0.940
161.70	0.940	0.952	0.963
166.70	0.957	0.965	0.974
171.70	0.968	0.976	0.985
176.70	0.977	0.983	0.989
181.70	0.986	0.990	0.995
186.70	0.990	0.993	0.997
191.70	0.993	0.995	0.998
196.70	0.995	0.998	0.999

Step 9 q_w = 0.130m²/s		x = 400mm, y = 0mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.004	0.004
11.70	0.004	0.006	0.011
16.70	0.006	0.008	0.012
21.70	0.008	0.011	0.018
26.70	0.010	0.015	0.024
29.20	0.012	0.020	0.030
31.70	0.019	0.027	0.034
33.70	0.021	0.034	0.048
35.70	0.032	0.045	0.059
37.70	0.053	0.068	0.083
39.70	0.072	0.087	0.102
41.70	0.095	0.115	0.135
43.70	0.120	0.155	0.190
45.70	0.160	0.204	0.248
47.70	0.220	0.252	0.283
49.70	0.263	0.302	0.340
51.70	0.323	0.363	0.403
53.70	0.375	0.427	0.478
55.70	0.433	0.482	0.531
57.70	0.503	0.552	0.601
59.70	0.558	0.596	0.633
61.70	0.588	0.633	0.678
63.70	0.651	0.684	0.718
65.70	0.683	0.728	0.773
67.70	0.736	0.767	0.798
69.70	0.761	0.787	0.813
71.70	0.796	0.817	0.838
73.70	0.828	0.848	0.868
75.70	0.841	0.866	0.891
77.70	0.856	0.876	0.896
79.70	0.875	0.892	0.910

81.70	0.893	0.908	0.923
83.70	0.911	0.925	0.939
86.70	0.916	0.931	0.946
91.70	0.948	0.956	0.964
96.70	0.952	0.964	0.976
101.70	0.967	0.976	0.985
106.70	0.980	0.986	0.991
111.70	0.983	0.989	0.996
116.70	0.991	0.996	0.998
121.70	0.994	0.997	0.998
126.70	0.995	0.998	0.999

Step 9 $q_w = 0.130$m²/s		$x = 600$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.003	0.005	0.007
9.20	0.005	0.009	0.014
11.70	0.011	0.020	0.028
14.20	0.023	0.035	0.047
16.70	0.041	0.055	0.070
19.20	0.049	0.068	0.088
21.70	0.072	0.090	0.108
24.20	0.101	0.119	0.137
26.70	0.132	0.159	0.185
29.20	0.160	0.191	0.223
31.70	0.198	0.234	0.270
34.20	0.230	0.268	0.305
36.70	0.268	0.300	0.333
39.20	0.300	0.340	0.380
41.70	0.353	0.389	0.425
44.20	0.378	0.424	0.470
46.70	0.430	0.473	0.515
49.20	0.465	0.519	0.573
51.70	0.495	0.539	0.583
54.20	0.540	0.571	0.603
56.70	0.588	0.616	0.645
59.20	0.610	0.648	0.685
61.70	0.643	0.671	0.700
64.20	0.668	0.701	0.735
66.70	0.695	0.731	0.768
69.20	0.728	0.758	0.788
71.70	0.760	0.789	0.818
74.20	0.785	0.814	0.843
76.70	0.800	0.826	0.853
79.20	0.818	0.846	0.875
81.70	0.828	0.856	0.885
84.20	0.854	0.874	0.894
86.70	0.869	0.885	0.901
89.20	0.872	0.893	0.914
91.70	0.896	0.913	0.930
96.70	0.915	0.931	0.947
101.70	0.938	0.946	0.955
106.70	0.946	0.957	0.968
111.70	0.958	0.966	0.974
116.70	0.968	0.973	0.979
121.70	0.974	0.981	0.987
126.70	0.979	0.985	0.992
131.70	0.984	0.989	0.994
136.70	0.989	0.992	0.996
141.70	0.993	0.995	0.997

Step 9 $q_w = 0.130$m²/s		$x = 1000$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
6.70	0.001	0.001	0.001
11.70	0.004	0.005	0.006
16.70	0.005	0.009	0.016
21.70	0.012	0.015	0.024
26.70	0.020	0.026	0.042
31.70	0.038	0.057	0.076
36.70	0.100	0.125	0.150
39.70	0.140	0.178	0.215
41.70	0.168	0.220	0.273
43.70	0.208	0.255	0.303
45.70	0.245	0.300	0.355
47.70	0.313	0.360	0.408
49.70	0.373	0.439	0.505
51.70	0.425	0.488	0.550
53.70	0.475	0.525	0.575
55.70	0.543	0.593	0.643
57.70	0.593	0.645	0.698
59.70	0.663	0.701	0.740
61.70	0.708	0.744	0.780
63.70	0.743	0.779	0.815
65.70	0.783	0.828	0.873
67.70	0.825	0.856	0.888

69.70	0.850	0.880	0.910
71.70	0.894	0.909	0.923
73.70	0.907	0.932	0.957
76.70	0.926	0.949	0.971
81.70	0.966	0.978	0.990
86.70	0.989	0.994	0.998
91.70	0.996	0.999	1.000

Step 9 $q_w = 0.130$m²/s		$x = 1200$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
11.70	0.001	0.001	0.001
16.70	0.002	0.003	0.005
21.70	0.003	0.005	0.008
26.70	0.006	0.011	0.017
31.70	0.015	0.026	0.037
36.70	0.047	0.069	0.091
39.70	0.079	0.115	0.151
41.70	0.114	0.158	0.202
43.70	0.155	0.191	0.227
45.70	0.200	0.236	0.272
47.70	0.252	0.291	0.330
49.70	0.295	0.345	0.395
51.70	0.370	0.417	0.465
53.70	0.420	0.476	0.532
55.70	0.460	0.519	0.577
57.70	0.537	0.591	0.645
59.70	0.620	0.660	0.700
61.70	0.662	0.710	0.757
63.70	0.720	0.759	0.797
65.70	0.747	0.795	0.842
67.70	0.780	0.829	0.877
69.70	0.810	0.854	0.897
71.70	0.852	0.885	0.917
73.70	0.877	0.905	0.932
75.70	0.904	0.926	0.949
77.70	0.922	0.941	0.960
79.70	0.934	0.952	0.970
81.70	0.941	0.960	0.979
83.70	0.955	0.970	0.984
86.70	0.967	0.979	0.991
91.70	0.980	0.986	0.993
96.70	0.988	0.992	0.996
101.70	0.992	0.995	0.998
106.70	0.995	0.998	1.000

Step 9 $q_w = 0.130$m²/s		$x = 1400$mm, $y = 0$mm	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
16.70	0.001	0.001	0.001
21.70	0.001	0.002	0.003
26.70	0.002	0.004	0.006
31.70	0.004	0.006	0.011
33.70	0.005	0.008	0.013
35.70	0.007	0.011	0.022
37.70	0.010	0.019	0.039
39.70	0.018	0.030	0.045
41.70	0.029	0.040	0.058
43.70	0.047	0.063	0.088
45.70	0.075	0.095	0.115
47.70	0.108	0.136	0.164
49.70	0.143	0.175	0.208
51.70	0.188	0.231	0.275
53.70	0.245	0.296	0.348
55.70	0.328	0.368	0.408
57.70	0.410	0.450	0.490
59.70	0.463	0.499	0.535
61.70	0.518	0.570	0.623
63.70	0.593	0.624	0.655
65.70	0.638	0.673	0.708
67.70	0.693	0.739	0.785
69.70	0.750	0.806	0.863
71.70	0.803	0.836	0.870
73.70	0.830	0.859	0.888
75.70	0.863	0.898	0.933
77.70	0.894	0.914	0.934
79.70	0.909	0.930	0.951
81.70	0.932	0.950	0.967
83.70	0.941	0.960	0.971
85.70	0.954	0.968	0.978
87.70	0.964	0.978	0.987
89.70	0.980	0.988	0.994
91.70	0.984	0.991	0.995
93.70	0.985	0.994	0.997
95.70	0.991	0.995	0.997
97.70	0.995	0.998	0.998

Step 9 $q_w = 0.130 m^2/s$		$x = 1600 mm, y = 0 mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
26.70	0.001	0.001	0.002
31.70	0.001	0.002	0.003
36.70	0.002	0.004	0.008
39.70	0.004	0.009	0.018
41.70	0.011	0.022	0.034
43.70	0.014	0.028	0.041
45.70	0.025	0.047	0.069
47.70	0.040	0.070	0.100
49.70	0.071	0.101	0.131
51.70	0.113	0.152	0.190
53.70	0.165	0.213	0.261
55.70	0.220	0.267	0.313
57.70	0.318	0.361	0.403
59.70	0.373	0.423	0.474
61.70	0.441	0.496	0.551
63.70	0.526	0.589	0.651
65.70	0.591	0.649	0.707
67.70	0.634	0.694	0.754
69.70	0.714	0.764	0.814
71.70	0.727	0.787	0.847
73.70	0.799	0.839	0.879
75.70	0.854	0.888	0.922
77.70	0.875	0.901	0.927
79.70	0.900	0.925	0.950
81.70	0.932	0.947	0.961
83.70	0.943	0.957	0.970
85.70	0.957	0.970	0.983
87.70	0.964	0.977	0.990
89.70	0.975	0.984	0.993
91.70	0.977	0.984	0.991
96.70	0.986	0.992	0.996
101.70	0.992	0.997	0.999

Step 9 $q_w = 0.130 m^2/s$		$x = 1800, y = 0 mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.000	0.000	0.000
29.70	0.001	0.001	0.002
31.70	0.001	0.001	0.003
33.70	0.001	0.002	0.008
35.70	0.001	0.004	0.006
37.70	0.002	0.005	0.014
39.70	0.007	0.011	0.029
41.70	0.009	0.019	0.035
43.70	0.022	0.043	0.069
45.70	0.044	0.066	0.089
47.70	0.085	0.126	0.168
49.70	0.153	0.188	0.223
51.70	0.208	0.258	0.308
53.70	0.288	0.348	0.408
55.70	0.401	0.457	0.513
57.70	0.493	0.548	0.603
59.70	0.563	0.623	0.684
61.70	0.646	0.695	0.744
63.70	0.734	0.772	0.811
65.70	0.809	0.840	0.871
67.70	0.834	0.865	0.896
69.70	0.886	0.911	0.936
71.70	0.898	0.927	0.957
73.70	0.919	0.951	0.974
75.70	0.958	0.976	0.987
77.70	0.971	0.986	0.993
79.70	0.985	0.995	0.998
81.70	0.993	0.998	0.999
83.70	0.989	0.999	1.000
85.70	0.997	1.000	1.000

Step 9 $q_w = 0.130 m^2/s$		$x = 2200 mm, y = 0 mm$	
z	C (30s of 180s)		
[mm]	Min	Mean	Max
1.70	0.001	0.001	0.001
33.70	0.001	0.002	0.004
34.70	0.001	0.002	0.004
35.70	0.001	0.006	0.011
36.70	0.001	0.010	0.019
37.70	0.002	0.015	0.027
38.70	0.008	0.021	0.035
39.70	0.012	0.032	0.052
40.70	0.016	0.038	0.059
41.70	0.031	0.059	0.087
42.70	0.053	0.089	0.125
43.70	0.078	0.109	0.140
44.70	0.088	0.133	0.178
45.70	0.135	0.183	0.230

47.70	0.210	0.256	0.303
49.70	0.330	0.375	0.420
51.70	0.438	0.491	0.545
53.70	0.523	0.579	0.635
55.70	0.645	0.689	0.733
57.70	0.713	0.755	0.798
59.70	0.795	0.829	0.863
61.70	0.840	0.879	0.918
63.70	0.885	0.916	0.948
65.70	0.927	0.944	0.960
67.70	0.943	0.961	0.980
69.70	0.966	0.980	0.995
71.70	0.975	0.984	0.994
73.70	0.982	0.989	0.996
75.70	0.987	0.992	0.997
77.70	0.992	0.995	0.998
79.70	0.994	0.996	0.998
81.70	0.995	0.996	0.998

Step 9 $q_w = 0.130 m^2/s$		$x = 2300mm, y = 0mm$	
z		C (30s of 180s)	
[mm]	Min	Mean	Max
1.70		0.000	
36.70		0.003	
37.70		0.005	
38.70		0.013	
39.70		0.015	
40.70		0.020	
41.70		0.025	
42.70		0.045	
43.70		0.058	
44.70		0.088	
45.70		0.113	
46.70		0.138	
47.70		0.175	
48.70		0.225	
49.70		0.275	
50.70		0.300	
51.70		0.338	
52.70		0.413	
53.70		0.488	
54.70		0.538	
55.70		0.575	
56.70		0.625	
57.70		0.663	
58.70		0.700	
59.70		0.725	
60.70		0.775	
61.70		0.825	
62.70		0.838	
63.70		0.863	
64.70		0.888	
65.70		0.900	
66.70		0.925	
67.70		0.938	
68.70		0.950	
69.70		0.958	
70.70		0.965	
71.70		0.970	
73.70		0.975	
75.70		0.990	
77.70		0.995	
81.70		0.998	

Step 9 $q_w = 0.130 m^2/s$		$x = 2400mm, y = 0mm$	
z		C (30s of 180s)	
[mm]	Min	Mean	Max
0.75	0.001	0.001	0.001
28.75	0.001	0.001	0.001
29.75	0.001	0.001	0.004
30.75	0.001	0.002	0.012
31.75	0.001	0.003	0.013
32.75	0.001	0.004	0.015
33.75	0.004	0.010	0.022
34.75	0.006	0.015	0.029
36.75	0.014	0.035	0.061
38.75	0.047	0.073	0.100
40.75	0.113	0.133	0.153
42.75	0.163	0.208	0.253
44.75	0.248	0.288	0.328
46.75	0.335	0.404	0.473
48.75	0.463	0.506	0.550
50.75	0.583	0.619	0.655
52.75	0.648	0.694	0.740
54.75	0.710	0.769	0.828
56.75	0.790	0.824	0.858
58.75	0.835	0.874	0.913
60.75	0.873	0.908	0.943

62.75	0.913	0.932	0.951
64.75	0.944	0.961	0.979
66.75	0.958	0.973	0.987
68.75	0.968	0.979	0.990
70.75	0.973	0.984	0.994
72.75	0.984	0.992	0.997
74.75	0.984	0.995	0.999
76.75	0.992	0.997	0.999

H.3 AIR-CONCENTRATION CONTOUR SECTIONS

Longitudinal air-concentration contour sections can be developed by combining multiple vertical profiles. These are presented in Figure H-2 to Figure H-6. On each figure the following information is plotted:

- Distribution of time-average air concentration at each location; and
- Contour lines of constant time-average air concentration, for C = 10%, 50%, 90% and 99%.

Flow depth data recorded with the pointer gauge (Appendix F) is presented where available for comparison.

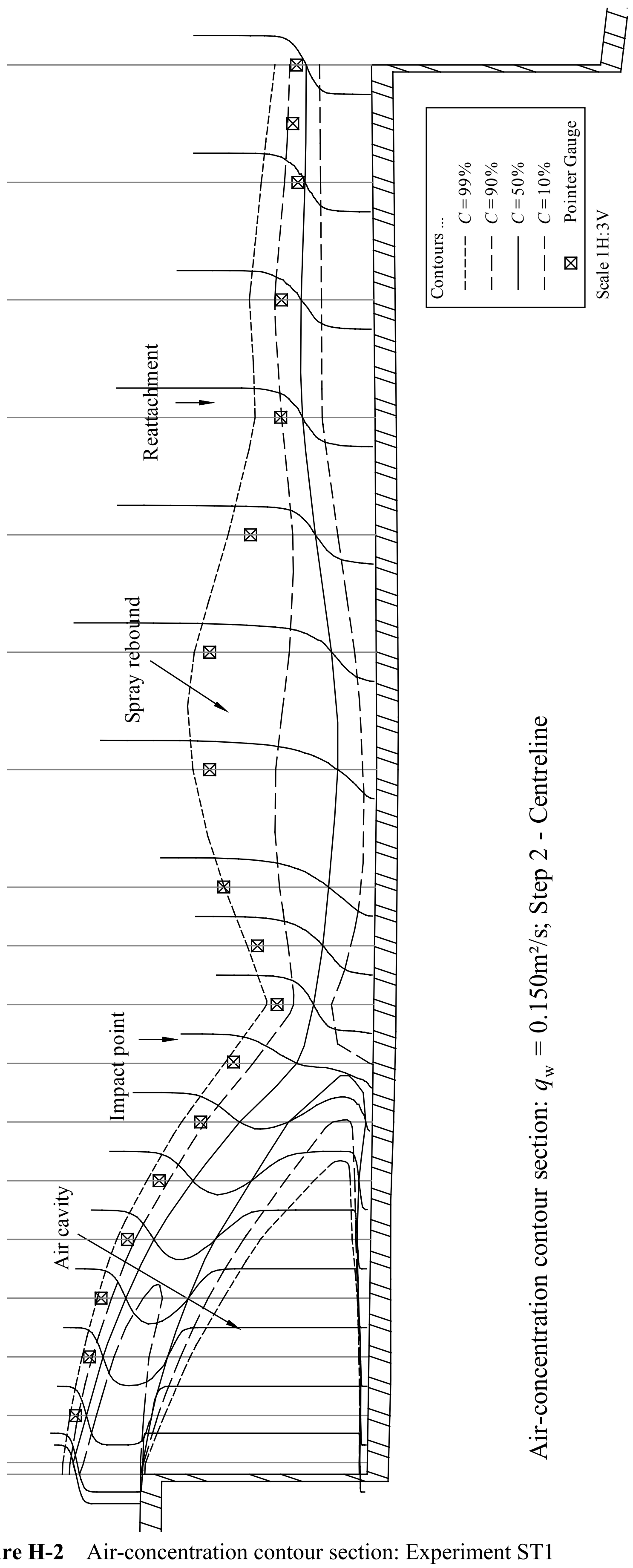

Figure H-2 Air-concentration contour section: Experiment ST1 Step 2, $q_w = 0.15$m²/s, $Y = 0$ (centreline)

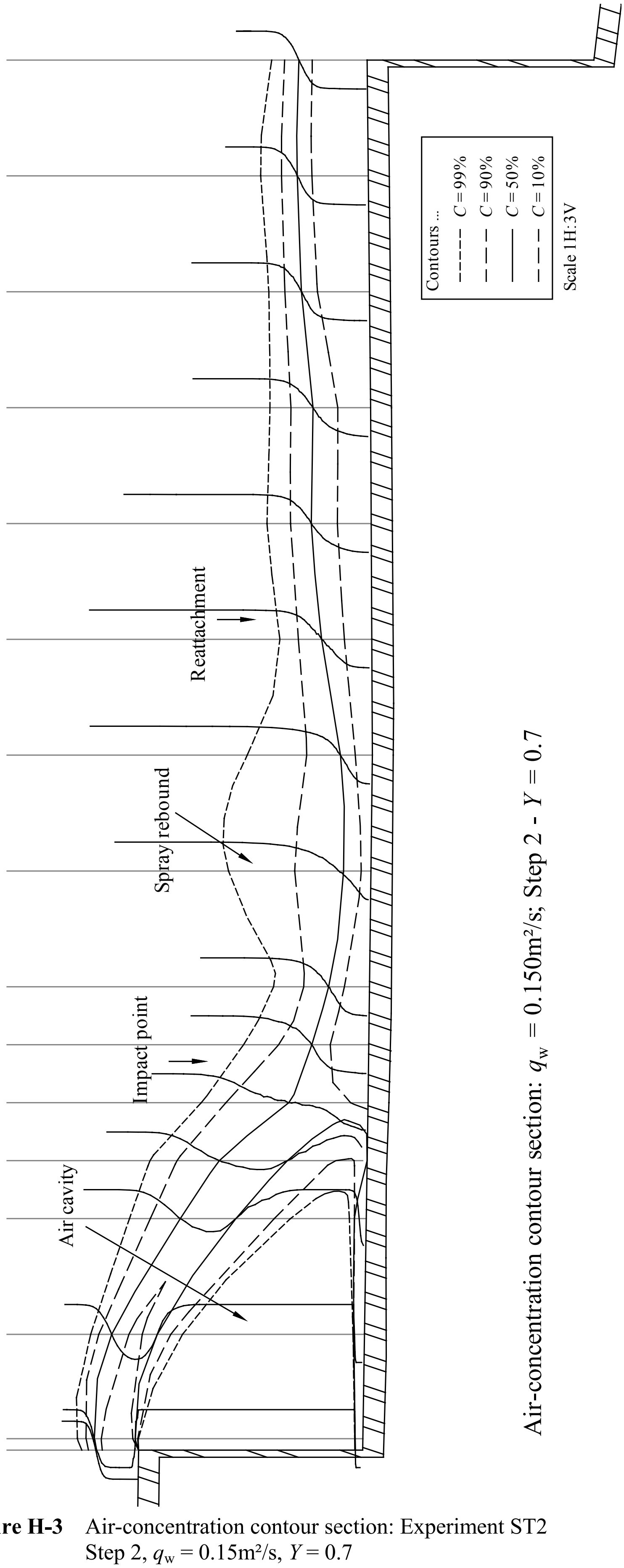

Figure H-3 Air-concentration contour section: Experiment ST2
Step 2, $q_w = 0.15\text{m}^2/\text{s}$, $Y = 0.7$

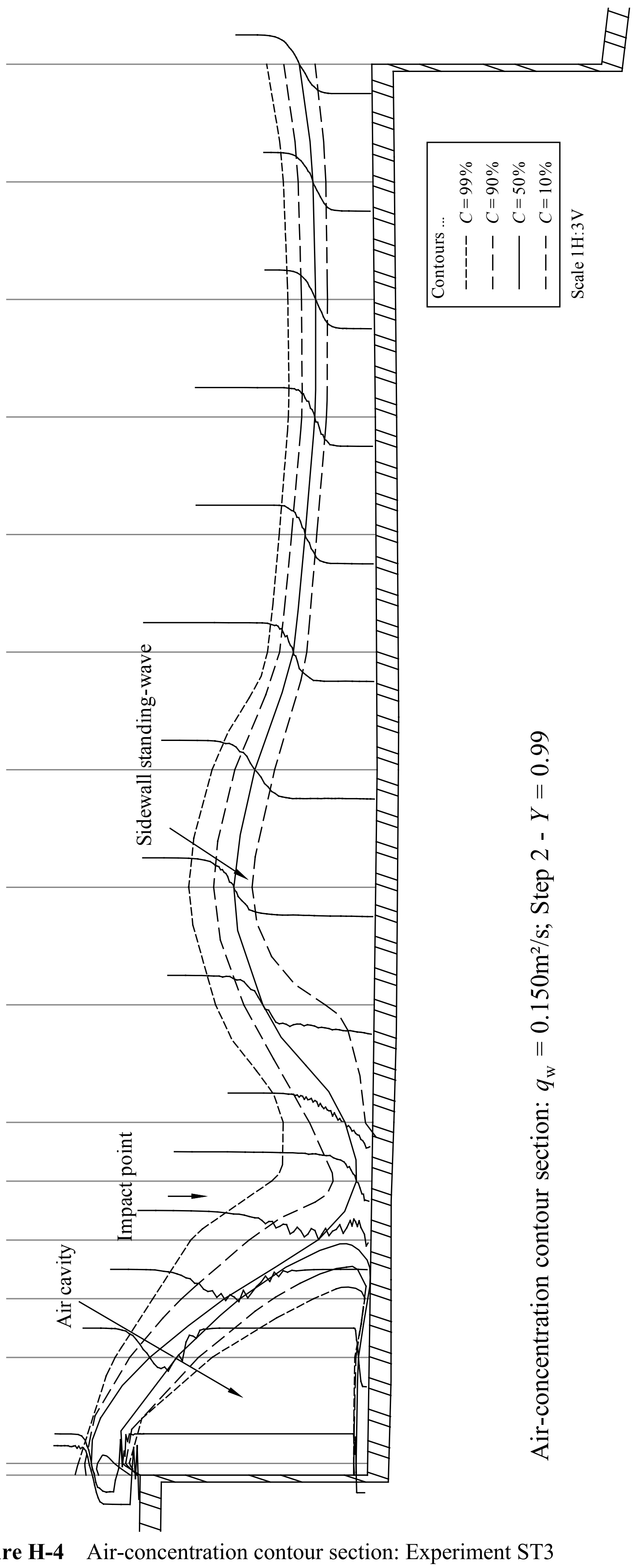

Figure H-4 Air-concentration contour section: Experiment ST3 Step 2, $q_w = 0.15 \text{m}^2/\text{s}$, $Y = 0.99$

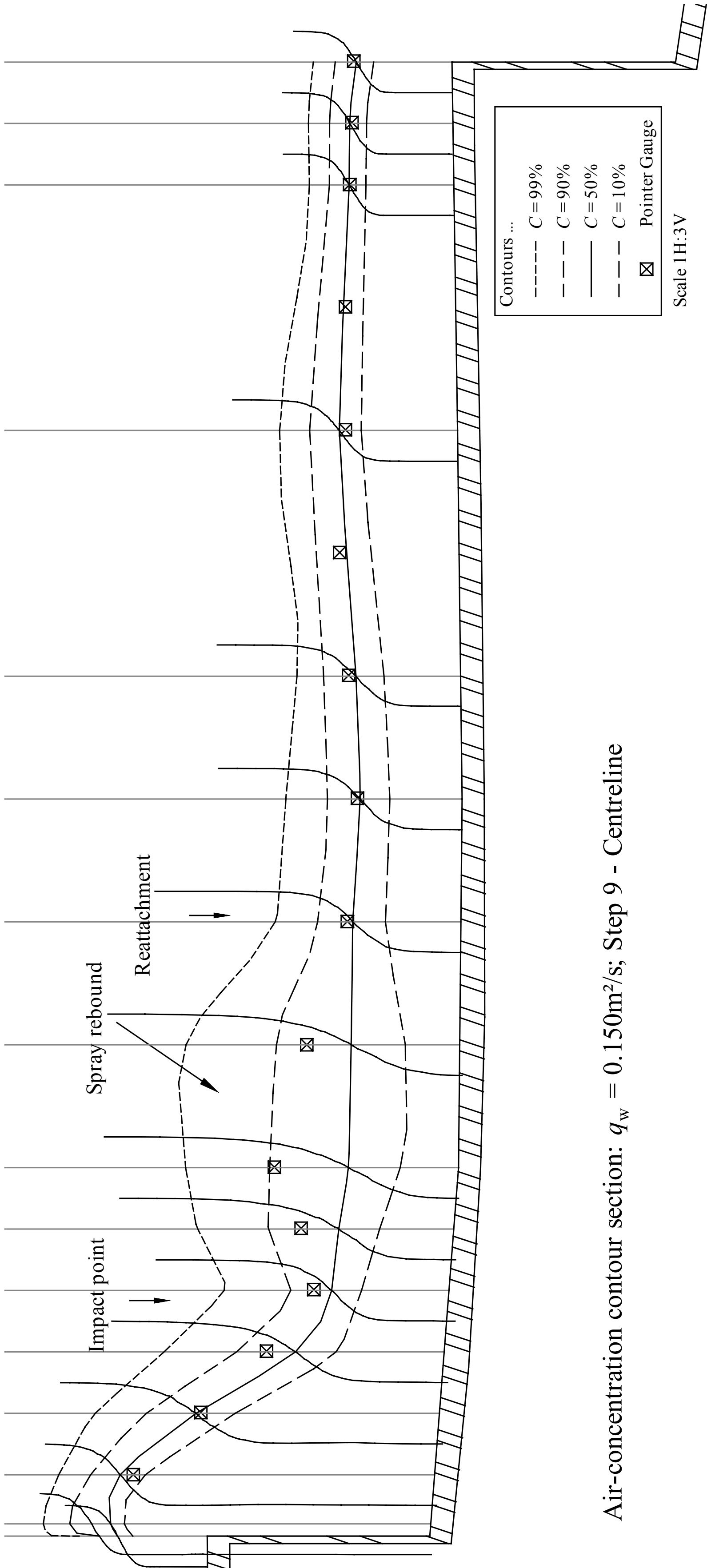

Figure H-5 Air-concentration contour section: Experiment ST4
Step 9, $q_w = 0.15 m^2/s$, $Y = 0$ (centreline)

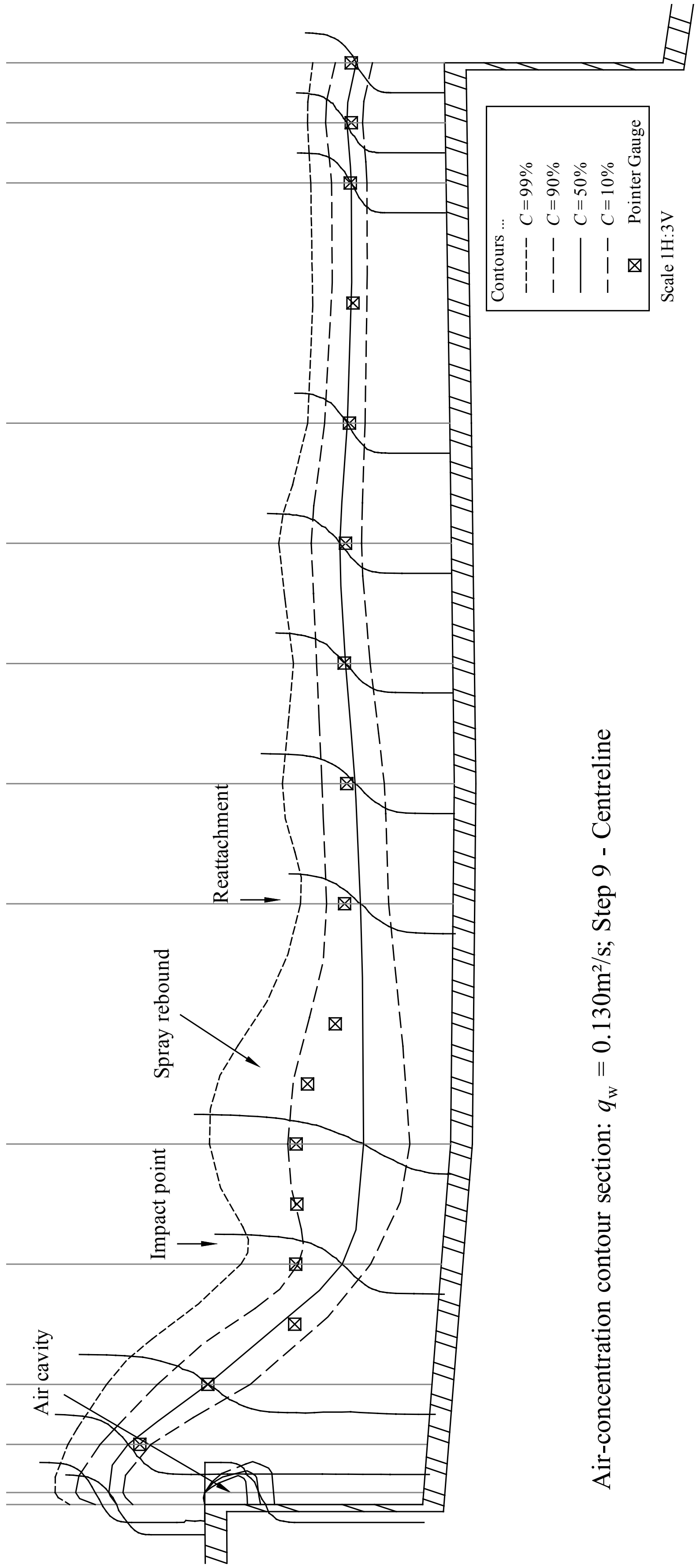

Figure H-6 Air-concentration contour section: Experiment ST5 Step 9, $q_w = 0.13$m²/s, $Y = 0$ (centreline)

APPENDIX I – DOUBLE-TIP CONDUCTIVITY PROBE AND PITOT TUBE DATA

I.1 DESCRIPTION

A double-tip conductivity probe (Figure I-1) and Pitot tube (Figure I-2) were used to investigate the air-water flow characteristics on the single-step model (Table I-1). The double-tip conductivity probe was used to investigate the air-water mixture properties. A Pitot tube was used to perform velocity and pressure measurements in clearwater flow. Sample time for each point was 10s. The scanning frequency was 40kHz and 10kHz for the conductivity probe and Pitot tube respectively.

Flow conditions are listed in Table I-2. Experimental data for elevation, velocity, mean air concentration, bubble frequency, mean chord-length, pressure head and total head (z, V, C, F_a, ch_a, P and H respectively) are listed in Section I.2 (Table I-3 to Table I-7).

Table I-1 Experimental channel details

		Single-step
Channel Properties	– Upstream length	0.62m
	– Downstream length	2.5m
	– Upstream width	0.237m
	– Downstream width	0.25m
Step Properties	– Step height, h	0.143m
Intake Characteristics	– Intake height	0.035m – 0.06m
	– Contraction coefficient	0.63 – 0.68

Table I-2 Experimental flow conditions

Exp.	Flowrate Q_w [L/s]	Gate Opening D [mm]	d_0 [mm]	V_0 [m/s]	Data	Page
DT1	20.0	46	30.6	2.76	Table I-3	I-3
DT2	23.0	46	29.0	3.35	Table I-4	I-19
DT3	26.3	46	29.6	3.75	Table I-5	I-36
DT4	20.7	35	24.3	3.59	Table I-6	I-59
DT5	34.0	60	39.7	3.61	Table I-7	I-94

Notes: Y = Distance from Centreline ÷ (Channel Width / 2) = $2y/W$, i.e. $Y = 0$ is centreline, $Y = 1$ is channel wall.
d_0 = centreline clearwater flow depth measured 150mm upstream of the drop
V_0 = flow velocity, assuming two-dimensional flow and uniform velocity profile, i.e. $V_0 = Q_W / (d_0 W_{upstream})$

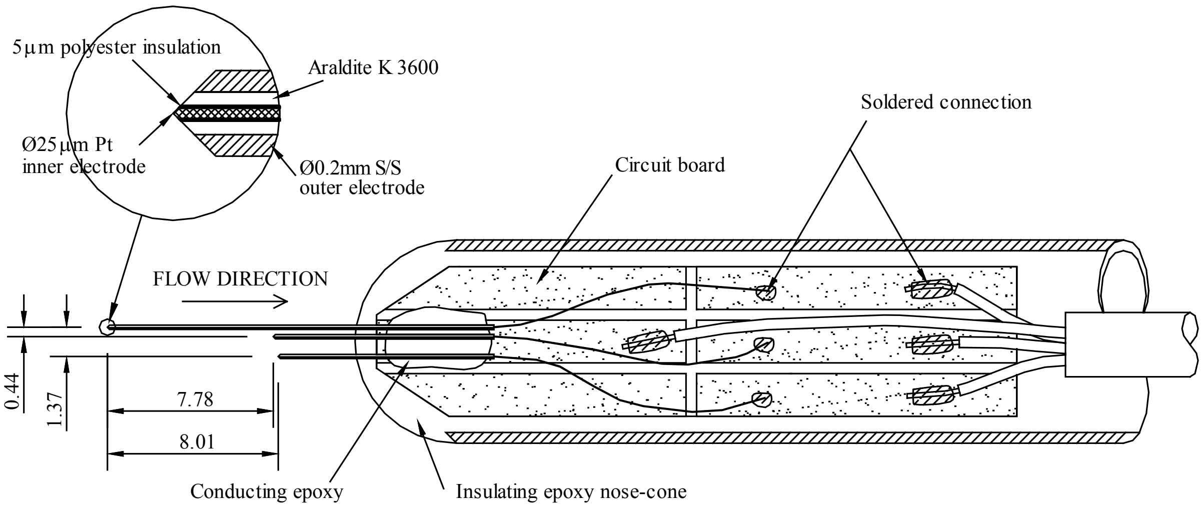

Figure I-1 Section through the double-tip conductivity probe tip

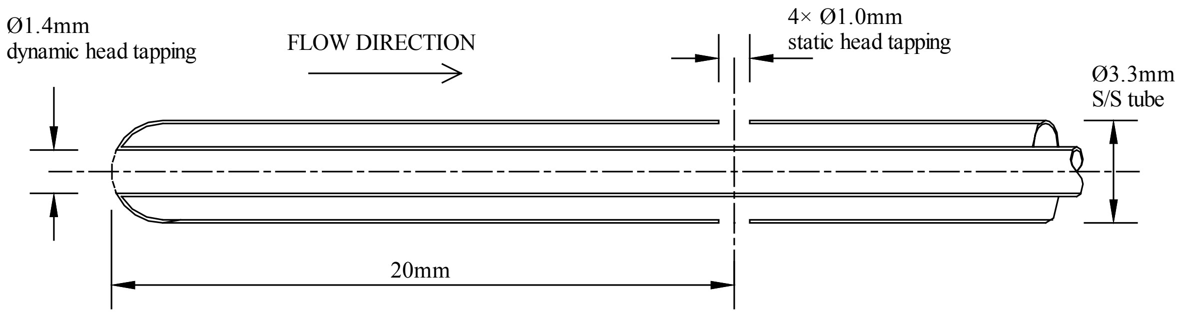

Figure I-2 Section through the Pitot tube tip

I.2 EXPERIMENTAL DATA

Table I-3 Double-tip conductivity probe data: Experiment DT1

x = -150mm, y = 0mm			Exp. DT1	Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
30.00	2.321	0.033	5.2	14.8	2	24.3	573.3
30.25	1.944	0.089	11.8	14.7	4	21.4	541.6
30.50	1.318	0.289	25.2	15.1	6	20.3	594.2
30.75	1.646	0.602	28.0	35.4	8	18.3	633.0
31.00	4.147	0.921	8.9	429.3	10	16.1	642.1
31.25	2.392	0.999	0.8	2986.5	12	13.8	648.3
31.50	5.016	0.994	0.5	9975.2	14	12.6	649.1
					16	10.7	649.8
					18	9.4	650.6
					20	8.4	650.1
					22	7.3	651.1
					24	5.4	649.7
					26	4.0	650.2
					28	9.2	650.1
					30	3.7	544.6

x = 0mm, y = 0mm			Exp. DT1	Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
172.50	1.787	0.013	3.6	6.4	145.5	3.0	399.3
172.75	2.175	0.081	20.6	8.6	147.5	4.0	488.2
173.00	2.130	0.215	37.3	12.3	149.5	5.8	551.3
173.25	2.130	0.450	49.8	19.2	151.5	7.1	601.9
173.50	2.190	0.756	35.1	47.2	153.5	8.5	634.0
173.75	2.206	0.872	20.8	92.4	155.5	9.2	637.2
174.00	2.270	0.941	13.0	164.4	157.5	9.6	646.9
174.25	3.110	0.978	2.8	1086.2	159.5	9.8	648.2
174.50	2.175	0.999	1.1	1974.5	161.5	10.2	649.1
					163.5	9.6	648.7
					165.5	8.5	649.0
					167.5	8.4	649.8
					169.5	6.4	649.0
					171.5	4.8	648.6
					173.5	1.6	512.0

x = 25mm, y = 0mm			Exp. DT1	Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
140.00	2.338	0.995	2.1	1107.4	143.5	-0.5	280.0
140.50	2.392	0.990	11.4	207.8	145.5	2.0	455.8
140.75	2.411	0.973	26.8	87.5	147.5	4.7	525.2

141.00	2.449	0.930	62.0	36.7	149.5	7.2	581.6
141.25	2.449	0.824	122.5	16.5	151.5	10.8	622.8
141.50	2.449	0.689	174.8	9.7	153.5	11.5	637.7
141.75	2.449	0.511	191.9	6.5	155.5	12.9	646.6
142.00	2.468	0.379	194.6	4.8	157.5	13.7	648.6
142.25	2.488	0.186	141.1	3.3	159.5	13.8	648.4
142.50	2.488	0.097	91.0	2.7	161.5	13.4	648.5
142.75	2.508	0.043	49.6	2.2	163.5	13.1	649.9
143.25	2.287	0.003	4.4	1.6	165.5	12.9	649.4
170.00	0.997	0.010	2.8	3.7	167.5	10.1	649.7
170.25	1.709	0.039	11.1	6.0	169.5	6.9	649.9
170.50	1.944	0.039	10.7	7.0	171.5	3.7	649.5
170.75	2.116	0.207	35.7	12.3	173.5	-0.3	587.3
171.00	2.160	0.620	37.3	35.9			
171.25	3.141	0.671	31.0	68.0			
171.50	2.528	0.897	20.3	111.8			
171.75	2.206	0.895	13.5	146.3			
172.00	2.592	0.962	8.7	286.5			
172.25	2.880	0.990	3.5	814.3			

x = 50mm, y = 0mm		Exp. DT1		Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
140.00	2.338	0.995	2.1	1107.4	143.5	-0.5	280.0
140.50	2.392	0.990	11.4	207.8	145.5	2.0	455.8
140.75	2.411	0.973	26.8	87.5	147.5	4.7	525.2
141.00	2.449	0.930	62.0	36.7	149.5	7.2	581.6
141.25	2.449	0.824	122.5	16.5	151.5	10.8	622.8
141.50	2.449	0.689	174.8	9.7	153.5	11.5	637.7
141.75	2.449	0.511	191.9	6.5	155.5	12.9	646.6
142.00	2.468	0.379	194.6	4.8	157.5	13.7	648.6
142.25	2.488	0.186	141.1	3.3	159.5	13.8	648.4
142.50	2.488	0.097	91.0	2.7	161.5	13.4	648.5
142.75	2.508	0.043	49.6	2.2	163.5	13.1	649.9
143.25	2.287	0.003	4.4	1.6	165.5	12.9	649.4
170.00	0.997	0.010	2.8	3.7	167.5	10.1	649.7
170.25	1.709	0.039	11.1	6.0	169.5	6.9	649.9
170.50	1.944	0.039	10.7	7.0	171.5	3.7	649.5
170.75	2.116	0.207	35.7	12.3	173.5	-0.3	587.3
171.00	2.160	0.620	37.3	35.9			
171.25	3.141	0.671	31.0	68.0			
171.50	2.528	0.897	20.3	111.8			
171.75	2.206	0.895	13.5	146.3			
172.00	2.592	0.962	8.7	286.5			
172.25	2.880	0.990	3.5	814.3			

x = 100mm, y = 0mm		Exp. DT1		Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
133.50	2.411	0.997	2.8	858.3	138.5	2.1	381.8
134.50	2.508	0.966	25.1	96.6	140.5	4.8	491.8
135.00	2.508	0.882	65.8	33.6	142.5	7.0	546.3
135.50	2.528	0.785	101.6	19.5	144.5	9.0	596.4
136.00	2.528	0.501	140.3	9.0	146.5	10.7	627.9
136.50	2.570	0.290	130.4	5.7	148.5	13.8	645.0
137.00	2.549	0.134	82.5	4.1	150.5	15.5	650.1
137.50	2.613	0.063	50.5	3.3	152.5	15.9	650.7
138.50	2.528	0.006	6.8	2.3	154.5	16.2	652.8
165.25	0.997	0.007	1.5	4.5	156.5	15.0	653.3
165.75	2.175	0.063	14.3	9.6	158.5	14.3	654.0
166.00	1.932	0.061	13.6	8.6	160.5	12.6	654.3
166.25	2.802	0.201	33.4	16.9	162.5	10.5	653.5
166.50	2.270	0.557	42.8	29.6	164.5	7.9	651.4
166.75	2.430	0.729	34.9	50.7	166.5	4.0	651.8
167.00	2.728	0.842	30.7	74.8	168.5	-1.3	590.4
167.25	2.549	0.950	12.6	192.2			
167.50	2.728	0.966	8.0	329.5			
168.00	2.356	0.956	6.2	363.2			

x = 200mm, y = 0mm		Exp. DT1		Q_w = 20L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
110.00	2.411	0.998	1.1	2186.4	116.5	-2.1	153.8
112.00	2.508	0.976	11.0	222.5	118.5	-2.0	272.6
113.00	2.570	0.908	31.7	73.6	120.5	-1.5	425.3
114.00	2.592	0.772	65.1	30.7	122.5	2.8	489.8
114.50	2.636	0.726	74.2	25.8	124.5	5.6	532.8
115.00	2.636	0.630	86.9	19.1	126.5	7.4	571.1
115.50	2.613	0.562	95.3	15.4	128.5	11.0	594.9
116.00	2.613	0.410	85.8	12.5	130.5	13.0	619.6
117.00	2.613	0.192	66.0	7.6	132.5	14.3	635.0
118.00	2.613	0.059	30.2	5.1	134.5	14.7	636.5
120.00	2.681	0.014	6.9	5.5	136.5	15.1	638.8
146.50	1.690	0.013	3.9	5.6	138.5	14.7	638.6
147.00	3.206	0.097	17.9	17.4	140.5	14.3	640.1
147.50	2.321	0.263	35.0	17.4	142.5	12.5	639.6
147.75	2.549	0.294	40.4	18.5	144.5	9.8	640.0
148.00	2.321	0.509	35.0	33.7	146.5	6.5	640.6
148.25	2.356	0.590	45.8	30.4	148.5	3.3	640.5
148.50	2.449	0.750	31.1	59.1	150.5	-1.5	583.6
148.75	2.356	0.722	41.2	41.3			

149.00	2.430	0.866	21.2	99.2
149.50	2.508	0.923	11.2	206.7
150.00	2.338	0.990	4.7	492.4

x = 300mm, y = 0mm		Exp. DT1	Q_w = 20L/s	D = 46mm			
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
110.00	2.411	0.998	1.1	2186.4	116.5	-2.1	153.8
112.00	2.508	0.976	11.0	222.5	118.5	-2.0	272.6
113.00	2.570	0.908	31.7	73.6	120.5	-1.5	425.3
114.00	2.592	0.772	65.1	30.7	122.5	2.8	489.8
114.50	2.636	0.726	74.2	25.8	124.5	5.6	532.8
115.00	2.636	0.630	86.9	19.1	126.5	7.4	571.1
115.50	2.613	0.562	95.3	15.4	128.5	11.0	594.9
116.00	2.613	0.410	85.8	12.5	130.5	13.0	619.6
117.00	2.613	0.192	66.0	7.6	132.5	14.3	635.0
118.00	2.613	0.059	30.2	5.1	134.5	14.7	636.5
120.00	2.681	0.014	6.9	5.5	136.5	15.1	638.8
146.50	1.690	0.013	3.9	5.6	138.5	14.7	638.6
147.00	3.206	0.097	17.9	17.4	140.5	14.3	640.1
147.50	2.321	0.263	35.0	17.4	142.5	12.5	639.6
147.75	2.549	0.294	40.4	18.5	144.5	9.8	640.0
148.00	2.321	0.509	35.0	33.7	146.5	6.5	640.6
148.25	2.356	0.590	45.8	30.4	148.5	3.3	640.5
148.50	2.449	0.750	31.1	59.1	150.5	-1.5	583.6
148.75	2.356	0.722	41.2	41.3			
149.00	2.430	0.866	21.2	99.2			
149.50	2.508	0.923	11.2	206.7			
150.00	2.338	0.990	4.7	492.4			

x = 500mm, y = 0mm		Exp. DT1	Q_w = 20L/s	D = 46mm			x = 500mm, y = 25mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.190	0.063	92.2	1.5	5.0	2.116	0.093	128.8	1.5
10.0	2.392	0.071	94.5	1.8	10.0	2.101	0.100	128.0	1.6
15.0	2.704	0.054	71.1	2.0	15.0	2.449	0.102	129.7	1.9
20.0	2.853	0.033	39.6	2.4	20.0	2.681	0.086	107.1	2.2
25.0	3.079	0.018	23.5	2.4	25.0	2.853	0.077	90.4	2.4
30.0	2.962	0.009	10.2	2.7	30.0	3.049	0.076	51.4	4.5
32.0	3.110	0.003	4.0	2.5	31.0	2.934	0.119	58.2	6.0
33.0	2.853	0.008	6.4	3.7	32.0	2.802	0.170	57.2	8.3
34.0	2.681	0.023	5.6	11.1	33.0	2.592	0.310	47.1	17.0
35.0	2.392	0.063	13.4	11.2	34.0	2.287	0.434	46.9	21.2
36.0	2.549	0.222	21.1	26.8	35.0	2.321	0.565	40.4	32.5
37.0	2.221	0.435	26.6	36.3	36.0	2.190	0.666	34.7	42.1

38.0	2.338	0.705	18.6	88.7
39.0	2.392	0.798	15.8	120.9
40.0	2.033	0.797	15.3	105.8
41.0	2.636	0.927	6.4	381.7
42.0	2.101	0.965	4.0	507.2
43.0	2.468	0.964	4.8	495.7
45.0	2.254	0.992	1.7	1314.5
50.0	2.449	0.999	0.2	12233.8

37.0	2.206	0.827	26.1	69.9
38.0	2.304	0.824	26.1	72.7
39.0	2.254	0.869	24.1	81.3
40.0	2.073	0.945	8.8	222.6
41.0	2.321	0.951	9.7	227.5
42.0	2.488	0.963	9.6	249.6
43.0	2.254	0.969	8.1	269.6
45.0	2.728	0.990	3.0	900.1
50.0	1.798	0.998	0.8	2243.4

x = 500mm, y = 50mm Exp. DT1 Q_w = 20L/s D = 46mm x = 500mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.411	0.064	95.7	1.6
10.0	2.549	0.070	96.7	1.8
15.0	2.658	0.075	88.9	2.2
20.0	2.853	0.058	61.3	2.7
25.0	2.990	0.033	32.9	3.0
28.0	3.141	0.022	23.3	2.9
30.0	3.206	0.017	14.2	3.8
31.0	2.853	0.035	14.1	7.0
32.0	2.880	0.077	15.4	14.4
33.0	2.468	0.200	20.9	23.6
34.0	2.681	0.314	22.2	37.9
35.0	2.592	0.602	25.7	60.7
36.0	2.374	0.709	20.3	82.9
37.0	2.508	0.835	16.6	126.1
38.0	2.449	0.890	11.3	192.8
39.0	2.508	0.965	5.6	432.3
40.0	2.853	0.978	4.2	664.4
42.0	2.658	0.992	1.7	1550.5
45.0	3.309	0.998	0.7	4715.1

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.468	0.077	99.2	1.9
10.0	2.430	0.082	104.5	1.9
15.0	2.392	0.092	109.9	2.0
20.0	2.777	0.052	61.3	2.4
25.0	2.934	0.041	46.5	2.6
27.0	2.802	0.017	20.7	2.3
28.0	2.880	0.038	37.1	3.0
29.0	2.962	0.031	19.9	4.6
30.0	3.173	0.069	25.1	8.8
31.0	2.962	0.143	36.7	11.5
32.0	2.802	0.208	36.7	15.9
33.0	2.549	0.483	36.6	33.7
34.0	2.802	0.618	33.8	51.2
35.0	2.752	0.673	36.6	50.6
36.0	2.528	0.863	20.5	106.4
37.0	2.592	0.911	17.0	138.9
38.0	2.356	0.965	5.0	454.8
40.0	2.636	0.989	3.9	668.7
42.0	2.880	0.995	1.6	1790.1

x = 500mm, y = 100mm Exp. DT1 Q_w = 20L/s D = 46mm x = 500mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.145	0.107	133.5	1.7
10.0	2.130	0.107	139.6	1.6
15.0	2.613	0.105	124.6	2.2
20.0	2.636	0.118	138.5	2.2
23.0	2.990	0.125	129.0	2.9
25.0	3.019	0.174	115.4	4.5
26.0	2.934	0.206	128.3	4.7
27.0	2.934	0.321	122.9	7.7
28.0	2.962	0.387	111.0	10.3

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.237	0.031	52.5	1.3
10.0	2.190	0.043	71.4	1.3
15.0	2.449	0.064	91.9	1.7
20.0	2.802	0.118	120.5	2.7
22.0	2.934	0.176	138.2	3.7
24.0	3.049	0.318	203.5	4.8
26.0	2.853	0.395	197.3	5.7
28.0	2.827	0.516	220.9	6.6
30.0	2.728	0.567	218.1	7.1

29.0	2.853	0.443	112.8	11.2
30.0	2.827	0.629	90.7	19.6
31.0	2.853	0.657	78.6	23.9
32.0	2.802	0.767	68.4	31.4
33.0	2.777	0.841	52.8	44.2
34.0	2.777	0.857	50.8	46.8
35.0	2.728	0.887	38.3	63.2
36.0	2.880	0.944	25.6	106.2
37.0	2.880	0.951	23.1	118.5
38.0	2.777	0.965	23.4	114.5
40.0	2.752	0.981	9.0	299.9
42.0	2.802	0.993	6.1	456.0
45.0	2.019	0.997	2.0	1006.4

32.0	2.728	0.644	202.7	8.7
34.0	2.570	0.706	174.1	10.4
36.0	2.570	0.762	138.2	14.2
38.0	2.592	0.776	130.2	15.5
40.0	2.728	0.831	97.6	23.2
42.0	2.570	0.856	71.0	31.0
44.0	2.592	0.795	98.7	20.9
46.0	3.019	0.890	50.1	53.7
48.0	2.449	0.834	67.8	30.1
50.0	2.338	0.887	40.0	51.9
52.0	2.338	0.868	48.9	41.5
55.0	2.033	0.912	28.0	66.2
60.0	1.757	0.957	13.9	121.0
65.0	1.517	0.975	8.8	168.2
70.0	1.352	0.986	4.2	317.5
80.0	1.307	1.000	0.6	2176.9

x = 600mm, *y* = 0mm — Exp. DT1 — Q_w = 20L/s — *D* = 46mm — *x* = 600mm, *y* = 25mm

z [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]
5.0	2.528	0.028	63.5	1.1
10.0	2.658	0.035	66.5	1.4
15.0	2.777	0.044	74.1	1.7
20.0	2.827	0.046	52.9	2.5
22.0	2.802	0.066	55.9	3.3
24.0	2.752	0.112	58.1	5.3
25.0	2.880	0.175	69.8	7.2
26.0	2.777	0.270	62.6	12.0
27.0	2.728	0.336	67.6	13.5
28.0	2.704	0.484	64.7	20.2
29.0	2.777	0.591	63.0	26.0
30.0	2.728	0.705	50.6	38.0
31.0	2.752	0.744	51.0	40.2
32.0	2.728	0.779	48.1	44.2
33.0	2.802	0.847	41.7	56.9
34.0	2.853	0.886	30.8	82.1
36.0	2.728	0.926	28.0	90.2
40.0	2.728	0.960	18.7	140.1
45.0	2.658	0.975	16.4	158.1
50.0	2.636	0.981	11.6	223.0
60.0	2.570	0.992	5.6	455.5
70.0	2.430	0.998	2.3	1053.9

z [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]
5.0	2.570	0.040	82.9	1.3
10.0	2.549	0.056	98.1	1.5
15.0	2.549	0.080	123.4	1.7
20.0	2.592	0.105	123.0	2.2
24.0	2.728	0.194	152.8	3.5
26.0	2.728	0.219	156.3	3.8
28.0	2.728	0.296	130.0	6.2
30.0	2.752	0.341	142.3	6.6
32.0	2.777	0.426	138.8	8.5
34.0	2.681	0.542	124.0	11.7
36.0	2.777	0.630	123.5	14.2
38.0	2.802	0.688	105.3	18.3
40.0	2.752	0.751	88.8	23.3
42.0	2.681	0.800	79.3	27.0
44.0	2.704	0.846	70.8	32.3
46.0	2.704	0.885	51.5	46.5
50.0	2.704	0.913	44.0	56.1
55.0	2.777	0.952	32.8	80.6
60.0	2.777	0.970	18.5	145.6
70.0	2.549	0.990	6.6	382.5
80.0	2.549	0.997	2.3	1105.1

Exp. DT1 Q_w = 20L/s D = 46mm

x = 600mm, y = 50mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.592	0.037	70.5	1.4
10.0	2.592	0.050	82.8	1.6
15.0	2.728	0.087	98.6	2.4
18.0	2.752	0.116	103.4	3.1
20.0	2.704	0.193	117.6	4.4
22.0	2.752	0.305	113.1	7.4
24.0	2.728	0.438	120.0	10.0
26.0	2.704	0.481	115.7	11.2
28.0	2.752	0.605	111.1	15.0
30.0	2.802	0.702	96.7	20.3
32.0	2.880	0.726	88.9	23.5
34.0	2.827	0.770	78.9	27.6
36.0	2.752	0.825	68.1	33.3
38.0	2.777	0.875	55.7	43.6
41.0	2.752	0.865	64.4	37.0
45.0	2.777	0.909	46.4	54.4
50.0	2.827	0.952	28.4	94.8
55.0	2.853	0.969	22.7	121.8
60.0	2.934	0.987	11.9	243.3
70.0	2.508	0.990	6.4	388.2
80.0	2.449	0.998	1.7	1437.0

x = 600mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.658	0.036	65.9	1.5
10.0	2.636	0.050	73.3	1.8
14.0	2.681	0.095	95.7	2.7
16.0	2.752	0.121	93.2	3.6
18.0	2.777	0.241	88.4	7.6
19.0	2.777	0.284	102.4	7.7
20.0	2.728	0.323	122.8	7.2
21.0	2.752	0.424	106.8	10.9
22.0	2.752	0.509	89.7	15.6
23.0	2.777	0.548	103.0	14.8
24.0	2.752	0.622	93.6	18.3
25.0	2.777	0.660	101.8	18.0
26.0	2.728	0.732	76.0	26.3
27.0	2.752	0.775	71.3	29.9
28.0	2.802	0.802	60.8	36.9
29.0	2.728	0.843	59.8	38.5
30.0	2.752	0.846	61.9	37.6
32.0	2.752	0.870	58.7	40.8
35.0	2.704	0.921	39.0	63.8
40.0	2.728	0.956	25.9	100.7
45.0	2.592	0.977	16.3	155.3
50.0	2.613	0.987	9.7	266.0
60.0	2.752	0.996	3.1	884.6
70.0	3.206	1.000	0.6	5341.7

Exp. DT1 Q_w = 20L/s D = 46mm

x = 600mm, y = 100mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.430	0.052	83.5	1.5
10.0	2.468	0.078	101.0	1.9
14.0	2.449	0.137	147.3	2.3
16.0	2.508	0.155	146.3	2.7
18.0	2.658	0.192	162.1	3.2
20.0	2.636	0.227	152.2	3.9
22.0	2.704	0.329	172.2	5.2
24.0	2.636	0.392	165.2	6.3
26.0	2.658	0.521	167.3	8.3
28.0	2.777	0.613	148.3	11.5
30.0	2.658	0.636	141.0	12.0
32.0	2.704	0.749	111.7	18.1
34.0	2.681	0.771	104.7	19.7
36.0	2.704	0.815	92.9	23.7
38.0	2.636	0.854	76.6	29.4

x = 600mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.270	0.041	73.6	1.3
10.0	2.430	0.055	96.7	1.4
15.0	2.430	0.079	118.8	1.6
20.0	2.449	0.151	176.3	2.1
25.0	2.528	0.247	209.5	3.0
30.0	2.613	0.365	205.7	4.6
35.0	2.728	0.508	209.6	6.6
40.0	2.728	0.643	186.9	9.4
45.0	2.704	0.697	170.4	11.1
50.0	2.613	0.704	148.4	12.4
55.0	2.570	0.757	131.0	14.9
60.0	2.508	0.817	84.3	24.3
65.0	2.430	0.832	82.5	24.5
70.0	2.206	0.897	47.6	41.6
75.0	2.160	0.933	26.8	75.2

40.0	2.658	0.872	70.6	32.8	80.0	2.338	0.970	13.8	164.4
42.0	2.802	0.919	47.4	54.3	85.0	1.920	0.989	5.5	345.2
45.0	2.528	0.918	52.6	44.1	90.0	2.658	0.996	1.5	1765.7
50.0	2.528	0.967	20.5	119.2	100.0	1.709	0.999	0.5	3415.8
55.0	2.304	0.964	21.8	101.9					
60.0	2.237	0.982	11.5	191.0					
70.0	1.646	0.980	6.3	256.1					
80.0	1.646	0.992	2.9	562.9					

x = 700mm, y = 0mm Exp. DT1 Q_w = 20L/s D = 46mm x = 700mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.570	0.017	35.2	1.2	5.0	2.570	0.024	49.0	1.2
10.0	2.728	0.039	57.4	1.9	10.0	2.613	0.051	73.8	1.8
12.0	2.802	0.051	63.0	2.3	15.0	2.681	0.124	107.3	3.1
14.0	2.802	0.073	69.7	3.0	18.0	2.681	0.179	117.6	4.1
16.0	2.880	0.109	75.2	4.2	21.0	2.728	0.231	122.7	5.1
18.0	2.853	0.178	83.4	6.1	24.0	2.752	0.270	133.2	5.6
20.0	2.853	0.288	89.8	9.1	27.0	2.777	0.352	140.6	7.0
22.0	2.853	0.486	82.6	16.8	30.0	2.802	0.455	140.5	9.1
24.0	2.907	0.566	88.1	18.7	33.0	2.827	0.572	130.6	12.4
26.0	2.907	0.706	84.5	24.3	36.0	2.827	0.673	123.4	15.4
28.0	2.853	0.756	76.8	28.1	39.0	2.802	0.731	112.7	18.2
30.0	2.907	0.837	66.6	36.5	42.0	2.802	0.794	99.0	22.5
32.0	2.853	0.867	63.9	38.7	45.0	2.827	0.832	80.7	29.2
35.0	2.802	0.904	49.1	51.6	50.0	2.752	0.884	68.9	35.3
40.0	2.802	0.939	43.8	60.1	55.0	2.704	0.924	47.7	52.4
45.0	2.777	0.956	32.2	82.5	60.0	2.681	0.954	29.4	87.0
50.0	2.658	0.964	29.2	87.8	70.0	2.528	0.974	20.2	121.9
60.0	2.613	0.982	15.9	161.4	80.0	2.430	0.988	10.7	224.2
75.0	2.468	0.995	4.5	545.6	90.0	2.287	0.996	3.5	651.0
90.0	2.592	0.999	1.2	2158.1					

x = 700mm, y = 50mm Exp. DT1 Q_w = 20L/s D = 46mm x = 700mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.488	0.036	62.7	1.4	5.0	2.392	0.040	56.6	1.7
10.0	2.613	0.071	84.9	2.2	8.0	2.658	0.067	68.7	2.6
15.0	2.658	0.136	112.5	3.2	10.0	2.704	0.109	90.5	3.3
18.0	2.777	0.249	132.2	5.2	12.0	2.827	0.155	98.3	4.5
21.0	2.777	0.327	136.4	6.7	14.0	2.777	0.298	120.2	6.9
24.0	2.827	0.429	154.4	7.9	16.0	2.853	0.446	133.0	9.6
27.0	2.827	0.561	148.9	10.7	18.0	2.827	0.513	120.8	12.0
30.0	2.802	0.589	141.0	11.7	20.0	2.777	0.621	126.2	13.7

33.0	2.827	0.662	125.4	14.9	22.0	2.802	0.712	104.4	19.1
36.0	2.827	0.755	108.7	19.6	24.0	2.802	0.735	109.6	18.8
39.0	2.853	0.797	99.4	22.9	26.0	2.777	0.781	97.2	22.3
42.0	2.802	0.842	82.5	28.6	28.0	2.752	0.813	90.2	24.8
45.0	2.853	0.862	77.0	31.9	30.0	2.777	0.857	80.4	29.6
50.0	2.802	0.898	61.4	41.0	35.0	2.728	0.888	68.6	35.3
55.0	2.704	0.932	40.8	61.7	40.0	2.728	0.919	54.1	46.3
60.0	2.658	0.951	37.6	67.2	45.0	2.658	0.934	45.2	54.9
70.0	2.592	0.978	16.6	152.7	50.0	2.636	0.957	32.0	78.8
80.0	2.636	0.985	10.5	247.2	60.0	2.528	0.974	18.9	130.3
90.0	2.270	0.993	5.2	433.4	75.0	2.270	0.993	4.4	512.6
					90.0	2.190	0.996	3.0	727.0

x = 700mm, y = 100mm		Exp. DT1	Q_w = 20L/s			D = 46mm		x = 700mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.374	0.061	73.0	2.0	5.0	2.145	0.015	31.8	1.0
9.0	2.570	0.125	109.6	2.9	10.0	2.270	0.028	52.1	1.2
12.0	2.613	0.226	135.8	4.3	15.0	2.304	0.045	74.2	1.4
15.0	2.592	0.272	151.0	4.7	20.0	2.237	0.061	94.5	1.4
18.0	2.613	0.307	163.5	4.9	25.0	2.321	0.087	111.5	1.8
21.0	2.636	0.377	157.4	6.3	30.0	2.374	0.134	138.4	2.3
24.0	2.636	0.487	157.2	8.2	35.0	2.392	0.193	160.0	2.9
27.0	2.658	0.530	161.3	8.7	40.0	2.508	0.278	173.0	4.0
30.0	2.636	0.644	136.1	12.5	45.0	2.430	0.324	166.0	4.7
33.0	2.636	0.692	129.5	14.1	50.0	2.374	0.357	156.8	5.4
36.0	2.613	0.751	109.0	18.0	55.0	2.356	0.418	149.0	6.6
39.0	2.570	0.788	102.0	19.9	60.0	2.356	0.537	124.9	10.1
42.0	2.508	0.816	87.3	23.5	65.0	2.046	0.541	122.4	9.0
45.0	2.570	0.876	70.6	31.9	70.0	2.101	0.688	89.2	16.2
50.0	2.508	0.893	56.5	39.6	75.0	2.190	0.781	64.4	26.5
55.0	2.411	0.915	49.1	44.9	80.0	2.101	0.857	47.1	38.2
60.0	2.304	0.921	41.1	51.6	85.0	2.101	0.919	27.3	70.7
70.0	2.254	0.965	21.0	103.6	90.0	2.145	0.970	11.5	180.9
85.0	2.033	0.986	7.3	274.7	95.0	1.968	0.985	6.7	289.4
100.0	2.101	0.999	0.5	4198.3	100.0	1.994	0.992	3.4	581.8

x = 800mm, y = 0mm		Exp. DT1	Q_w = 20L/s			D = 46mm		x = 800mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.613	0.046	58.6	2.1	5.0	2.508	0.037	58.7	1.6
8.0	2.613	0.044	60.1	1.9	8.0	2.449	0.037	56.2	1.6
10.0	2.570	0.082	71.2	3.0	10.0	2.570	0.051	67.2	2.0
12.0	2.802	0.135	88.8	4.2	12.0	2.613	0.084	91.7	2.4

14.0	2.802	0.234	105.6	6.2
16.0	2.827	0.311	112.6	7.8
18.0	2.827	0.448	106.4	11.9
20.0	2.827	0.576	106.7	15.3
22.0	2.802	0.672	97.7	19.3
24.0	2.827	0.752	88.4	24.0
26.0	2.802	0.792	81.5	27.2
28.0	2.802	0.845	70.9	33.4
30.0	2.827	0.860	66.8	36.4
32.0	2.802	0.883	64.6	38.3
35.0	2.777	0.922	48.3	53.0
40.0	2.752	0.933	41.3	62.2
45.0	2.681	0.953	33.3	76.7
50.0	2.728	0.968	23.7	111.4
60.0	2.549	0.982	15.4	162.5
70.0	2.488	0.986	11.3	217.1
80.0	2.411	0.995	3.9	615.1
90.0	2.356	0.997	2.7	869.7

14.0	2.613	0.127	102.8	3.2
16.0	2.613	0.151	112.8	3.5
18.0	2.658	0.192	113.2	4.5
20.0	2.704	0.271	126.9	5.8
22.0	2.777	0.325	132.1	6.8
24.0	2.777	0.371	128.1	8.0
26.0	2.802	0.487	134.7	10.1
28.0	2.802	0.537	131.0	11.5
30.0	2.802	0.610	120.0	14.2
32.0	2.802	0.668	114.9	16.3
34.0	2.827	0.732	99.0	20.9
36.0	2.827	0.754	97.2	21.9
39.0	2.802	0.834	75.9	30.8
42.0	2.802	0.860	72.6	33.2
45.0	2.777	0.890	58.6	42.2
50.0	2.728	0.919	50.2	49.9
55.0	2.704	0.948	35.2	72.8
60.0	2.704	0.953	29.8	86.5
70.0	2.613	0.978	15.9	160.7
80.0	2.468	0.989	10.5	232.4
90.0	2.321	0.996	3.4	679.6

x = 800mm, y = 50mm		Exp. DT1		Q_w = 20L/s		D = 46mm		x = 800mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.592	0.052	72.5	1.9	5.0	2.549	0.063	79.7	2.0
8.0	2.508	0.042	67.3	1.6	8.0	2.592	0.054	64.2	2.2
10.0	2.613	0.062	82.3	2.0	10.0	2.549	0.091	90.4	2.6
12.0	2.636	0.105	99.7	2.8	12.0	2.681	0.139	105.4	3.5
14.0	2.613	0.130	110.3	3.1	14.0	2.613	0.227	129.2	4.6
16.0	2.752	0.175	129.3	3.7	16.0	2.658	0.286	139.0	5.5
18.0	2.704	0.249	139.4	4.8	18.0	2.681	0.380	147.6	6.9
20.0	2.704	0.300	141.5	5.7	20.0	2.752	0.448	150.5	8.2
22.0	2.752	0.388	135.7	7.9	22.0	2.777	0.529	141.3	10.4
24.0	2.802	0.402	143.4	7.8	24.0	2.728	0.621	127.9	13.2
26.0	2.853	0.507	133.3	10.9	26.0	2.728	0.700	121.4	15.7
28.0	2.802	0.552	131.9	11.7	28.0	2.752	0.741	109.1	18.7
30.0	2.777	0.627	121.0	14.4	30.0	2.728	0.774	97.1	21.8
32.0	2.827	0.685	119.1	16.3	32.0	2.728	0.800	95.0	23.0
34.0	2.802	0.730	103.9	19.7	34.0	2.704	0.847	79.6	28.8
36.0	2.827	0.772	94.9	23.0	36.0	2.704	0.871	67.5	34.9
39.0	2.827	0.821	82.4	28.2	39.0	2.681	0.887	59.6	39.9
42.0	2.827	0.868	70.0	35.1	42.0	2.704	0.914	52.3	47.3
45.0	2.802	0.882	61.3	40.3	45.0	2.704	0.930	44.6	56.4

50.0	2.777	0.921	43.3	59.0
55.0	2.704	0.933	40.1	62.9
60.0	2.681	0.959	27.4	93.8
70.0	2.570	0.981	13.5	186.8
80.0	2.468	0.990	8.5	287.5
90.0	2.356	0.994	4.5	520.4

50.0	2.636	0.952	31.5	79.7
55.0	2.636	0.960	24.1	105.0
60.0	2.570	0.964	20.0	123.9
70.0	2.549	0.982	12.1	207.0
80.0	2.449	0.993	6.1	398.8
90.0	2.237	0.995	3.6	618.4

x = 800mm, y = 100mm Exp. DT1 Q_w = 20L/s D = 46mm x = 800mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.488	0.053	61.6	2.1
9.0	2.468	0.049	60.2	2.0
12.0	2.374	0.086	84.3	2.4
15.0	2.411	0.095	100.3	2.3
18.0	2.392	0.109	109.5	2.4
21.0	2.430	0.157	125.2	3.0
24.0	2.430	0.207	141.9	3.5
27.0	2.449	0.299	150.7	4.9
30.0	2.449	0.366	161.0	5.6
33.0	2.528	0.485	155.8	7.9
36.0	2.528	0.618	138.0	11.3
39.0	2.430	0.651	127.0	12.5
42.0	2.430	0.706	120.5	14.2
45.0	2.449	0.810	87.3	22.7
48.0	2.411	0.804	96.4	20.1
51.0	2.468	0.875	62.7	34.5
55.0	2.356	0.891	55.6	37.8
60.0	2.468	0.937	31.9	72.5
65.0	2.356	0.928	34.3	63.7
70.0	2.338	0.964	19.3	116.8
80.0	2.304	0.977	12.0	187.5
90.0	2.190	0.991	4.8	452.2
100.0	2.206	0.995	2.5	877.6

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.254	0.018	33.8	1.2
10.0	2.190	0.024	41.4	1.3
15.0	2.237	0.039	62.0	1.4
20.0	2.237	0.059	85.2	1.5
25.0	2.190	0.073	95.9	1.7
30.0	2.206	0.098	114.4	1.9
35.0	2.175	0.094	97.6	2.1
40.0	2.190	0.180	143.8	2.7
45.0	2.237	0.233	132.1	3.9
48.0	2.221	0.251	121.8	4.6
51.0	2.221	0.344	130.2	5.9
54.0	2.190	0.373	132.9	6.1
57.0	2.206	0.450	133.7	7.4
60.0	2.254	0.580	106.7	12.2
63.0	2.270	0.624	98.3	14.4
66.0	2.254	0.730	78.2	21.0
69.0	2.321	0.781	67.7	26.8
72.0	2.338	0.842	50.9	38.7
75.0	2.190	0.873	44.8	42.7
78.0	2.356	0.916	29.6	72.9
81.0	2.321	0.922	27.3	78.4
85.0	2.304	0.962	17.3	128.1
90.0	2.321	0.979	9.1	249.7
100.0	2.321	0.995	2.8	825.1

x = 1000mm, y = 0mm Exp. DT1 Q_w = 20L/s D = 46mm x = 1000mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.449	0.021	33.3	1.5
8.0	2.570	0.018	31.7	1.4
10.0	2.508	0.043	56.3	1.9
12.0	2.488	0.088	79.2	2.8
14.0	2.704	0.173	114.0	4.1
15.0	2.802	0.267	142.0	5.3

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.449	0.016	28.8	1.4
8.0	2.449	0.015	28.6	1.3
10.0	2.468	0.024	37.4	1.6
12.0	2.468	0.041	56.4	1.8
14.0	2.570	0.059	72.4	2.1
16.0	2.613	0.130	99.9	3.4

16.0	2.827	0.339	149.8	6.4	17.0	2.636	0.149	100.7	3.9
17.0	2.880	0.383	156.2	7.1	18.0	2.827	0.218	130.3	4.7
18.0	2.880	0.504	155.6	9.3	19.0	2.752	0.260	130.5	5.5
19.0	2.827	0.557	152.9	10.3	20.0	2.802	0.343	145.2	6.6
20.0	2.827	0.626	139.0	12.7	21.0	2.802	0.458	150.6	8.5
21.0	2.802	0.716	125.2	16.0	22.0	2.802	0.527	148.4	10.0
22.0	2.802	0.776	107.0	20.3	23.0	2.853	0.648	123.9	14.9
23.0	2.777	0.835	105.6	22.0	24.0	2.777	0.738	116.1	17.7
24.0	2.802	0.887	78.3	31.7	25.0	2.827	0.773	103.8	21.1
26.0	2.777	0.933	55.3	46.8	26.0	2.777	0.795	101.3	21.8
28.0	2.777	0.962	32.2	83.0	28.0	2.802	0.889	69.0	36.1
30.0	2.752	0.978	20.2	133.3	30.0	2.802	0.948	40.0	66.4
32.0	2.934	0.987	9.0	321.8	32.0	2.853	0.965	27.7	99.4
35.0	2.528	0.991	7.7	325.4	35.0	2.777	0.980	17.4	156.4
40.0	2.827	0.995	3.7	760.4	40.0	2.570	0.988	8.8	288.6
45.0	2.990	0.996	2.5	1191.8	45.0	2.827	0.992	5.4	519.6

x = 1000mm, y = 50mm		Exp. DT1		Q_w = 20L/s		D = 46mm		x = 1000mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.356	0.013	22.3	1.3	5.0	2.449	0.013	22.0	1.4
10.0	2.449	0.019	31.7	1.4	10.0	2.411	0.017	31.3	1.3
15.0	2.528	0.045	63.5	1.8	15.0	2.374	0.049	70.7	1.6
18.0	2.468	0.080	86.9	2.3	20.0	2.449	0.064	87.2	1.8
20.0	2.636	0.155	116.3	3.5	25.0	2.356	0.106	118.7	2.1
22.0	2.658	0.210	128.9	4.3	28.0	2.468	0.138	139.7	2.4
24.0	2.728	0.288	150.1	5.2	30.0	2.430	0.169	154.0	2.7
26.0	2.802	0.490	163.2	8.4	32.0	2.488	0.248	165.0	3.7
28.0	2.658	0.472	180.8	6.9	34.0	2.468	0.314	190.2	4.1
30.0	2.681	0.621	183.4	9.1	36.0	2.488	0.418	202.8	5.1
32.0	2.636	0.755	143.3	13.9	38.0	2.528	0.491	216.7	5.7
34.0	2.658	0.814	118.1	18.3	40.0	2.528	0.617	202.5	7.7
36.0	2.681	0.883	93.1	25.4	42.0	2.570	0.692	189.0	9.4
38.0	2.613	0.918	75.1	32.0	44.0	2.508	0.773	158.6	12.2
40.0	2.636	0.929	67.5	36.3	46.0	2.508	0.839	124.5	16.9
42.0	2.528	0.954	45.3	53.2	48.0	2.528	0.897	95.1	23.9
45.0	2.549	0.972	29.8	83.2	50.0	2.549	0.928	71.3	33.2
50.0	2.508	0.984	18.5	133.4	52.0	2.528	0.953	49.2	49.0
55.0	2.468	0.995	5.0	491.2	55.0	2.549	0.972	29.8	83.2
					60.0	2.488	0.991	10.4	237.0
					65.0	2.704	0.998	2.4	1124.0

x = 1000mm, y = 100mm		Exp. DT1		Q_w = 20L/s		D = 46mm		x = 1000mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.237	0.005	8.4	1.2	5.0	1.944	0.009	15.4	1.2
10.0	2.304	0.011	20.7	1.2	10.0	2.101	0.013	20.9	1.3
15.0	2.321	0.030	45.2	1.6	15.0	2.101	0.021	30.0	1.5
20.0	2.287	0.042	55.4	1.8	20.0	2.101	0.033	44.7	1.6
25.0	2.237	0.045	60.2	1.7	25.0	1.968	0.034	43.2	1.5
28.0	2.237	0.059	73.8	1.8	28.0	2.006	0.056	59.5	1.9
30.0	2.221	0.080	84.3	2.1	30.0	2.073	0.086	76.3	2.3
32.0	2.221	0.118	103.9	2.5	32.0	2.160	0.134	92.8	3.1
34.0	2.321	0.155	115.3	3.1	34.0	2.254	0.227	117.9	4.3
36.0	2.287	0.261	138.6	4.3	36.0	2.237	0.353	130.6	6.1
38.0	2.356	0.362	148.0	5.8	38.0	2.270	0.508	141.2	8.2
40.0	2.430	0.479	152.8	7.6	40.0	2.304	0.636	122.3	12.0
42.0	2.430	0.653	133.4	11.9	42.0	2.304	0.791	97.6	18.7
44.0	2.430	0.752	120.4	15.2	44.0	2.374	0.868	68.7	30.0
46.0	2.488	0.871	76.3	28.4	46.0	2.449	0.916	44.8	50.0
48.0	2.528	0.910	58.9	39.1	48.0	2.468	0.970	23.8	100.6
50.0	2.488	0.962	30.1	79.5	50.0	2.338	0.985	12.2	188.8
52.0	2.549	0.970	24.5	100.9	52.0	2.430	0.990	8.8	273.5
55.0	2.704	0.988	11.6	230.2	55.0	2.704	0.998	1.7	1588.2
60.0	2.636	0.995	3.3	795.0	60.0	2.392	0.999	0.6	3982.5
65.0	3.206	0.999	1.0	3202.0	65.0	1.555	1.000	0.4	3886.6

x = 1200mm, y = 0mm		Exp. DT1		Q_w = 20L/s		D = 46mm		x = 1200mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.304	0.005	6.7	1.7	10.0	2.488	0.004	7.1	1.4
14.0	2.430	0.018	24.2	1.8	14.0	2.374	0.020	26.0	1.8
16.0	2.175	0.030	35.0	1.8	16.0	2.411	0.050	48.6	2.5
18.0	2.449	0.075	68.9	2.7	18.0	2.374	0.114	83.4	3.2
20.0	2.658	0.165	124.3	3.5	20.0	2.613	0.184	114.3	4.2
22.0	2.528	0.285	164.2	4.4	22.0	2.592	0.286	145.2	5.1
24.0	2.880	0.428	204.1	6.0	24.0	2.570	0.467	169.6	7.1
26.0	2.827	0.519	210.9	7.0	26.0	2.681	0.626	170.7	9.8
28.0	2.880	0.626	217.5	8.3	28.0	2.592	0.605	180.7	8.7
30.0	2.752	0.689	195.1	9.7	30.0	2.636	0.724	153.2	12.5
32.0	2.853	0.774	169.3	13.0	32.0	2.658	0.831	118.5	18.6
34.0	2.802	0.820	145.8	15.7	34.0	2.704	0.889	95.3	25.2
36.0	2.728	0.886	104.7	23.1	36.0	2.613	0.933	62.2	39.2
38.0	2.853	0.920	83.3	31.5	38.0	2.613	0.920	63.6	37.8
40.0	2.681	0.946	64.1	39.6	40.0	2.636	0.956	44.7	56.4
42.0	2.752	0.963	46.1	57.5	42.0	2.704	0.965	28.9	90.3
45.0	2.728	0.984	21.0	127.9	45.0	2.681	0.988	11.6	228.4

50.0	2.658	0.996	5.0	529.5
55.0	2.549	0.999	0.8	3184.2

50.0	2.613	0.992	7.2	360.0
55.0	5.016	1.000	0.3	16716.3

x = 1200mm, y = 50mm   Exp. DT1 Q_w = 20L/s D = 46mm x = 1200mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.449	0.005	8.5	1.4
15.0	2.392	0.021	30.6	1.6
18.0	2.338	0.039	49.9	1.8
20.0	2.321	0.057	65.3	2.0
22.0	2.374	0.087	89.2	2.3
24.0	2.356	0.120	107.0	2.6
26.0	2.374	0.183	135.5	3.2
28.0	2.449	0.238	158.1	3.7
30.0	2.528	0.357	175.5	5.1
32.0	2.549	0.428	194.2	5.6
34.0	2.570	0.572	172.5	8.5
36.0	2.613	0.665	148.9	11.7
38.0	2.570	0.763	130.1	15.1
40.0	2.613	0.823	108.4	19.8
42.0	2.592	0.891	73.0	31.6
44.0	2.613	0.928	47.7	50.8
46.0	2.681	0.938	43.1	58.4
48.0	2.592	0.970	24.0	104.7
52.0	2.704	0.991	10.3	260.1
58.0	2.704	0.993	5.5	488.4

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.392	0.005	8.8	1.3
15.0	2.321	0.023	35.3	1.5
20.0	2.321	0.035	49.8	1.6
24.0	2.356	0.061	75.4	1.9
26.0	2.304	0.080	86.5	2.1
28.0	2.374	0.124	108.4	2.7
30.0	2.411	0.161	128.2	3.0
31.0	2.430	0.248	140.6	4.3
32.0	2.488	0.281	151.4	4.6
33.0	2.549	0.356	160.0	5.7
34.0	2.528	0.438	167.6	6.6
35.0	2.549	0.456	166.7	7.0
36.0	2.549	0.615	157.1	10.0
37.0	2.613	0.654	143.5	11.9
38.0	2.592	0.689	140.1	12.8
39.0	2.592	0.736	115.7	16.5
40.0	2.592	0.847	85.8	25.6
42.0	2.549	0.875	73.2	30.5
44.0	2.592	0.935	42.9	56.5
46.0	2.613	0.940	37.5	65.5
50.0	2.636	0.982	13.8	187.5
55.0	2.592	0.994	5.2	495.2

x = 1200mm, y = 100mm   Exp. DT1 Q_w = 20L/s D = 46mm x = 1200mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.145	0.002	3.5	1.2
15.0	2.221	0.008	11.5	1.5
20.0	2.175	0.020	30.2	1.5
23.0	2.175	0.028	36.1	1.7
25.0	2.254	0.052	54.5	2.1
27.0	2.287	0.077	70.8	2.5
28.0	2.304	0.111	83.5	3.1
29.0	2.392	0.166	98.9	4.0
30.0	2.468	0.235	111.3	5.2
31.0	2.411	0.318	119.7	6.4
32.0	2.449	0.378	127.7	7.2
33.0	2.549	0.479	129.6	9.4
34.0	2.528	0.567	115.7	12.4

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	1.873	0.007	10.4	1.2
15.0	1.932	0.021	27.0	1.5
20.0	1.968	0.029	36.8	1.6
23.0	2.033	0.055	52.3	2.1
25.0	2.116	0.085	66.2	2.7
27.0	2.101	0.130	95.9	2.8
28.0	2.101	0.176	109.5	3.4
29.0	2.116	0.255	130.8	4.1
30.0	2.190	0.316	138.1	5.0
31.0	2.116	0.379	141.7	5.7
32.0	2.206	0.499	140.0	7.9
33.0	2.237	0.565	140.4	9.0
34.0	2.221	0.610	144.1	9.4

35.0	2.528	0.689	113.7	15.3
36.0	2.549	0.734	96.1	19.5
37.0	2.592	0.817	85.7	24.7
38.0	2.570	0.880	67.0	33.8
39.0	2.570	0.918	49.4	47.7
40.0	2.570	0.939	36.8	65.6
42.0	2.592	0.981	12.9	197.1
45.0	2.658	0.989	7.6	345.8
50.0	2.907	0.999	0.9	3226.7

35.0	2.270	0.720	126.0	13.0
36.0	2.270	0.753	110.3	15.5
37.0	2.270	0.845	81.3	23.6
38.0	2.338	0.874	69.8	29.3
39.0	2.254	0.907	53.1	38.5
40.0	2.304	0.935	37.9	56.8
42.0	2.338	0.978	17.6	130.0
45.0	2.374	0.991	9.0	261.3
50.0	2.853	1.000	0.7	4074.6

x = 1800mm, y = 0mm Exp. DT1 Q_w = 20L/s D = 46mm x = 1800mm, y = 25mm

x = 1800mm, y = 0mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
20.0	2.338	0.001	2.4	1.2
25.0	2.006	0.004	5.2	1.4
27.0	2.704	0.018	16.7	2.9
28.0	2.658	0.050	36.4	3.6
29.0	2.704	0.094	60.6	4.2
30.0	2.704	0.146	91.0	4.3
31.0	2.728	0.215	112.1	5.2
32.0	2.728	0.385	159.9	6.6
33.0	2.728	0.493	189.9	7.1
34.0	2.728	0.644	192.0	9.1
35.0	2.728	0.787	174.5	12.3
36.0	2.728	0.858	136.9	17.1
37.0	2.728	0.895	116.6	20.9
38.0	2.752	0.941	77.6	33.4
39.0	2.777	0.971	39.1	69.0
40.0	2.681	0.985	22.7	116.3
42.0	2.752	0.995	10.7	256.0
45.0	2.728	0.999	3.2	851.4

x = 1800mm, y = 25mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
20.0	2.237	0.001	1.7	1.4
25.0	2.145	0.005	6.0	1.8
27.0	2.658	0.034	26.9	3.4
28.0	2.613	0.040	34.0	3.1
29.0	2.636	0.101	68.9	3.9
30.0	2.704	0.154	94.1	4.4
31.0	2.728	0.293	150.6	5.3
32.0	2.728	0.373	169.7	6.0
33.0	2.728	0.448	189.1	6.5
34.0	2.752	0.635	192.7	9.1
35.0	2.752	0.727	183.3	10.9
36.0	2.777	0.823	138.9	16.5
37.0	2.802	0.881	118.3	20.9
38.0	2.752	0.941	65.0	39.8
39.0	2.777	0.962	55.0	48.6
40.0	2.728	0.974	36.1	73.6
42.0	2.802	0.990	12.6	220.2
45.0	2.728	0.999	2.5	1089.9

x = 1800mm, y = 50mm Exp. DT1 Q_w = 20L/s D = 46mm x = 1800mm, y = 75mm

x = 1800mm, y = 50mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
25.0	2.374	0.002	3.0	1.9
27.0	2.392	0.007	8.3	2.1
28.0	2.636	0.018	16.1	3.0
29.0	2.549	0.031	26.9	2.9
30.0	2.704	0.074	53.6	3.7
31.0	2.681	0.126	84.6	4.0
32.0	2.728	0.195	116.4	4.6
33.0	2.728	0.305	155.8	5.3
34.0	2.704	0.374	175.4	5.8
35.0	2.704	0.441	182.8	6.5

x = 1800mm, y = 75mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
25.0	2.508	0.004	5.0	2.1
28.0	2.411	0.016	16.8	2.3
30.0	2.681	0.069	56.9	3.2
31.0	2.528	0.103	70.9	3.7
32.0	2.592	0.196	120.3	4.2
33.0	2.658	0.234	152.3	4.1
34.0	2.613	0.314	188.5	4.4
35.0	2.704	0.369	206.4	4.8
36.0	2.681	0.490	246.2	5.3
37.0	2.681	0.577	251.5	6.2

36.0	2.752	0.576	204.3	7.8	38.0	2.704	0.668	267.1	6.8
37.0	2.728	0.673	181.5	10.1	39.0	2.704	0.722	263.2	7.4
38.0	2.752	0.757	175.4	11.9	40.0	2.728	0.808	217.4	10.1
39.0	2.752	0.814	159.0	14.1	41.0	2.728	0.846	201.7	11.4
40.0	2.777	0.866	129.6	18.6	42.0	2.728	0.871	173.5	13.7
41.0	2.728	0.916	102.4	24.4	43.0	2.802	0.918	129.3	19.9
42.0	2.777	0.935	75.2	34.5	44.0	2.728	0.934	104.8	24.3
43.0	2.752	0.956	63.9	41.2	45.0	2.752	0.964	64.4	41.2
45.0	2.802	0.981	28.7	95.8	47.0	2.777	0.975	43.2	62.7
50.0	2.549	0.999	3.2	795.7	50.0	2.907	0.994	8.9	324.7

x = 1800mm, y = 100mm		Exp. DT1		Q_w = 20L/s		D = 46mm		x = 1800mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
22.0	2.287	0.002	2.3	2.0	15.0	1.885	0.002	3.0	1.4
25.0	2.488	0.033	24.2	3.4	20.0	1.718	0.007	6.8	1.7
26.0	2.430	0.068	36.1	4.6	22.0	1.896	0.013	10.4	2.3
27.0	2.468	0.120	61.0	4.9	24.0	1.757	0.057	31.3	3.2
28.0	2.449	0.169	83.7	5.0	25.0	1.690	0.100	39.6	4.3
29.0	2.374	0.287	120.4	5.7	26.0	1.672	0.146	58.1	4.2
30.0	2.449	0.358	131.1	6.7	27.0	1.798	0.213	71.2	5.4
31.0	2.488	0.456	159.7	7.1	28.0	1.620	0.317	101.4	5.1
32.0	2.508	0.583	173.5	8.4	29.0	1.728	0.382	106.8	6.2
33.0	2.549	0.617	194.9	8.1	30.0	1.728	0.471	120.6	6.7
34.0	2.549	0.700	198.1	9.0	31.0	1.798	0.641	108.3	10.6
35.0	2.549	0.765	194.1	10.0	32.0	1.777	0.681	110.5	11.0
36.0	2.613	0.815	199.3	10.7	33.0	1.709	0.747	105.8	12.1
37.0	2.613	0.872	156.4	14.6	34.0	1.777	0.811	89.8	16.0
38.0	2.704	0.899	132.8	18.3	35.0	1.718	0.824	88.3	16.0
39.0	2.704	0.922	117.2	21.3	36.0	1.885	0.868	74.1	22.1
40.0	2.658	0.937	92.6	26.9	37.0	1.956	0.918	66.5	27.0
42.0	2.658	0.969	64.1	40.2	38.0	1.920	0.936	48.3	37.2
45.0	2.658	0.990	18.8	140.0	40.0	1.862	0.968	34.7	52.0
50.0	3.274	0.999	2.2	1486.9	45.0	2.221	0.996	6.9	320.8

Table I-4 Double-tip conductivity probe data: Experiment DT2

x = -150mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
27.50	1.290	0.011	1.1	13.4	2	26.1	529.3
28.00	2.853	0.034	5.5	17.8	4	23.2	624.0
28.25	1.944	0.226	15.8	27.8	6	22.4	704.3
28.50	2.160	0.271	21.7	27.0	8	20.2	758.1
28.75	2.101	0.258	20.7	26.2	10	17.8	780.5
29.00	2.046	0.775	26.5	59.8	12	15.8	784.8
29.25	4.380	0.595	22.5	115.8	14	14.2	787.7
29.50	4.092	0.706	21.0	137.6	16	13.7	787.7
29.75	4.443	0.819	15.7	231.8	18	13.2	788.4
30.00	3.937	0.835	19.4	169.4	20	12.4	787.8
30.50	4.574	0.998	1.1	4149.3	22	10.8	788.4
					24	10.8	788.2
					26	18.4	788.1
					28	13.9	788.2

x = 0mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
171.00	2.681	0.011	2.6	11.2	145.5	5.8	432.5
171.50	2.990	0.119	19.5	18.3	147.5	8.1	598.6
171.75	2.827	0.193	34.4	15.9	149.5	10.9	648.1
172.00	3.019	0.519	43.7	35.9	151.5	13.9	717.5
172.25	3.173	0.511	45.9	35.3	153.5	15.7	746.6
172.50	2.728	0.609	40.7	40.8	155.5	16.7	769.1
172.75	2.827	0.786	29.6	75.1	157.5	17.3	782.6
173.00	2.681	0.774	33.2	62.5	159.5	18.4	778.9
173.25	2.658	0.950	9.9	255.1	161.5	18.2	783.9
173.50	2.907	0.956	3.9	712.2	163.5	17.1	784.7
174.00	2.827	0.995	1.6	1757.8	165.5	16.6	785.5
					167.5	14.5	785.4
					169.5	11.8	785.9
					171.5	10.3	785.1
					173.5	4.2	757.8

x = 50mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
140.00	2.592	0.996	4.3	600.2	141	2.3	153.0
140.50	2.549	0.987	15.9	158.2	143	4.3	402.9
140.75	2.613	0.971	32.2	78.8	145	7.7	539.9
141.00	2.613	0.915	78.6	30.4	147	11.0	632.8

141.25	2.658	0.831	128.7	17.2	149	13.4	717.5
141.50	2.728	0.749	174.9	11.7	151	16.4	724.8
141.75	2.658	0.554	210.0	7.0	153	17.4	764.9
142.00	2.613	0.304	187.4	4.2	155	18.7	758.8
142.25	2.728	0.225	169.6	3.6	157	18.9	779.2
142.50	2.613	0.061	69.0	2.3	159	19.3	781.2
142.75	2.728	0.057	70.4	2.2	161	18.8	782.2
143.25	2.728	0.008	13.4	1.6	163	19.3	785.0
169.00	2.356	0.006	2.3	6.1	165	19.6	784.3
169.50	2.880	0.022	5.7	11.3	167	16.5	785.0
169.75	3.456	0.069	14.1	16.9	169	13.0	785.3
170.00	2.802	0.190	36.0	14.8	171	8.4	779.7
170.25	2.907	0.450	51.4	25.4			
170.50	2.907	0.437	43.3	29.4			
170.75	2.962	0.731	35.8	60.5			
171.00	2.802	0.794	33.6	66.2			
171.25	2.658	0.776	39.7	52.0			
171.50	2.704	0.938	17.3	146.6			
172.00	2.990	0.973	3.0	969.9			

x = 100mm, y = 0mm		Exp. DT2		Q_w = 23L/s	D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
135.00	2.704	0.999	1.0	2701.4	138	3.5	348.3
136.00	2.681	0.981	14.1	186.6	140	6.4	549.8
136.50	2.681	0.938	42.3	59.4	142	10.3	613.6
137.00	2.658	0.759	104.6	19.3	144	12.7	654.7
137.50	2.827	0.817	103.7	22.3	146	15.6	707.0
138.00	2.827	0.594	147.4	11.4	148	16.9	742.7
138.50	2.907	0.414	166.2	7.2	150	18.9	756.7
139.00	2.907	0.256	138.6	5.4	152	19.6	751.3
139.50	2.934	0.091	65.9	4.1	154	19.8	768.8
140.00	2.990	0.063	62.6	3.0	156	19.4	779.6
141.00	3.049	0.011	15.4	2.1	158	20.3	782.7
164.00	2.907	0.013	3.0	12.1	160	18.3	784.9
164.50	2.704	0.012	3.5	9.2	162	16.0	784.9
165.00	3.110	0.135	20.4	20.7	164	13.0	785.1
165.50	3.019	0.217	34.7	18.9	166	8.5	784.1
166.00	2.827	0.502	36.1	39.3			
166.50	3.141	0.665	46.1	45.3			
167.00	3.141	0.774	34.4	70.7			
167.50	2.658	0.953	8.4	301.7			
168.00	2.907	0.964	7.0	400.1			
168.50	2.468	0.988	2.0	1218.7			

x = 200mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
118.0	2.681	0.990	5.9	450.1	126	2.8	350.3
120.0	2.728	0.896	38.9	62.8	128	6.7	547.1
121.0	2.962	0.937	30.7	90.4	130	9.5	659.4
121.5	2.907	0.855	51.1	48.6	132	12.5	701.9
122.0	2.934	0.818	69.1	34.7	134	14.5	715.3
122.5	2.907	0.705	78.8	26.0	136	16.4	742.3
123.0	2.934	0.580	83.2	20.5	138	16.8	765.1
123.5	2.990	0.607	102.8	17.6	140	17.0	773.4
124.0	2.990	0.401	95.2	12.6	142	17.1	770.3
124.5	3.019	0.414	93.0	13.4	144	16.0	774.5
125.0	3.049	0.380	108.3	10.7	146	16.3	779.3
125.5	3.049	0.242	94.8	7.8	148	14.2	783.3
126.0	3.019	0.170	57.4	9.0	150	12.0	784.4
127.0	3.110	0.059	36.4	5.1	152	9.4	780.8
129.0	3.079	0.020	15.7	4.0	154	5.3	750.3
150.0	2.777	0.008	2.6	8.9			
151.0	2.934	0.033	6.8	14.4			
151.5	2.827	0.278	35.1	22.4			
152.0	3.079	0.361	35.4	31.4			
152.5	2.907	0.500	43.6	33.3			
153.0	2.827	0.773	32.0	68.3			
153.5	2.907	0.750	41.9	52.1			
154.0	2.853	0.947	14.3	189.0			
154.5	2.752	0.979	4.0	673.7			
155.0	3.309	0.989	2.5	1308.3			
156.0	2.962	1.000	0.6	4934.6			

x = 300mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
93.0	3.049	0.999	1.0	3044.7	104	3.2	395.8
95.0	2.880	0.935	21.3	126.4	106	5.3	512.1
97.0	3.019	0.909	26.0	105.6	108	8.5	652.6
98.0	2.990	0.850	40.9	62.2	110	12.8	691.6
99.0	3.079	0.801	49.6	49.7	112	14.6	754.6
100.0	3.110	0.810	54.5	46.2	114	16.9	749.7
101.0	3.110	0.709	75.9	29.0	116	18.1	740.0
102.0	3.206	0.590	97.8	19.3	118	18.4	759.2
103.0	3.110	0.397	70.7	17.5	120	17.6	766.9
104.0	3.141	0.285	71.2	12.6	122	19.2	770.8
105.0	3.141	0.245	83.2	9.3	124	17.1	780.6
106.0	3.110	0.215	70.8	9.5	126	16.0	783.0

108.0	3.173	0.084	36.8	7.3	128	12.5	782.9
110.0	3.079	0.021	11.7	5.6	130	8.5	779.0
127.0	2.338	0.013	2.9	10.1	132	1.7	614.4
128.0	2.934	0.107	14.2	22.2			
128.5	3.747	0.067	13.0	19.3			
129.0	2.962	0.249	30.6	24.1			
129.5	3.019	0.464	41.4	33.9			
130.0	2.827	0.426	45.1	26.7			
130.5	2.777	0.663	36.5	50.4			
131.0	2.880	0.800	28.2	81.7			
131.5	2.853	0.931	17.4	152.7			
132.0	3.240	0.971	8.8	357.4			
133.0	2.681	0.998	0.8	3343.1			
134.0	2.752	0.995	0.2	13687.7			

x = 400mm, y = 0mm			Exp. DT2	Q_w = 23L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
60.0	2.934	0.981	7.0	411.3	73	0.3	289.4
63.0	3.206	0.943	15.8	191.4	75	2.9	428.7
66.0	3.206	0.863	36.0	76.9	77	7.4	602.8
68.0	3.240	0.816	46.8	56.5	79	7.0	555.0
69.0	3.240	0.652	62.2	33.9	81	13.7	731.1
70.0	3.206	0.677	56.6	38.4	83	14.7	760.3
71.0	3.206	0.526	55.3	30.5	85	15.5	775.3
72.0	3.274	0.642	70.9	29.6	87	15.9	776.1
73.0	3.240	0.524	80.5	21.1	89	15.1	780.3
74.0	3.240	0.372	83.2	14.5	91	14.0	780.6
75.0	3.240	0.350	69.2	16.4	93	16.7	778.4
76.0	3.240	0.271	61.0	14.4	95	11.6	780.1
77.0	3.173	0.158	43.0	11.7	97	7.1	699.1
79.0	3.240	0.085	33.0	8.4	99	4.3	691.2
82.0	3.274	0.025	11.4	7.2			
85.0	3.019	0.002	1.5	5.0			
90.0	2.430	0.004	0.8	12.0			
92.0	2.287	0.006	1.1	11.6			
93.0	2.752	0.032	6.2	14.1			
94.0	2.934	0.100	12.8	22.9			
95.0	3.141	0.198	20.8	30.0			
96.0	2.880	0.351	30.0	33.7			
97.0	3.110	0.622	35.7	54.2			
98.0	2.990	0.815	21.5	113.3			
99.0	3.309	0.947	10.0	313.4			
100.0	3.049	0.963	5.5	533.8			
102.0	2.990	0.997	1.3	2292.8			

x = 600mm, y = 0mm			Exp. DT2			Q_w = 23L/s		D = 46mm		x = 600mm, y = 25mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]		z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.962	0.048	116.8	1.2		5.0	2.592	0.044	96.1	1.2
10.0	2.752	0.069	145.3	1.3		10.0	2.962	0.047	94.0	1.5
15.0	2.853	0.097	170.6	1.6		15.0	3.110	0.044	72.1	1.9
20.0	2.962	0.084	140.0	1.8		20.0	3.019	0.053	79.8	2.0
25.0	3.141	0.079	124.9	2.0		25.0	3.019	0.045	59.1	2.3
28.0	3.240	0.086	110.8	2.5		27.0	3.049	0.106	66.6	4.9
30.0	2.990	0.151	102.1	4.4		28.0	2.934	0.201	60.9	9.7
31.0	2.907	0.223	90.8	7.1		29.0	3.079	0.304	66.6	14.0
32.0	2.934	0.273	91.5	8.7		30.0	3.141	0.386	67.6	17.9
33.0	2.777	0.448	78.5	15.9		31.0	3.019	0.491	67.2	22.1
34.0	2.934	0.498	79.7	18.3		32.0	3.110	0.527	70.4	23.3
35.0	2.907	0.589	74.1	23.1		33.0	3.240	0.633	64.5	31.8
36.0	2.962	0.748	60.4	36.7		34.0	3.110	0.732	53.5	42.6
37.0	2.827	0.748	60.9	34.7		35.0	3.240	0.730	60.7	39.0
38.0	2.880	0.855	39.2	62.8		36.0	3.206	0.758	66.1	36.8
39.0	2.704	0.889	34.7	69.3		37.0	3.206	0.811	60.2	43.2
40.0	2.907	0.897	28.1	92.8		38.0	3.079	0.877	40.2	67.2
42.0	2.752	0.940	22.3	116.0		39.0	3.173	0.919	27.3	106.9
45.0	2.934	0.970	14.4	197.6		40.0	3.206	0.923	28.3	104.6
50.0	3.049	0.986	6.8	442.1		42.0	3.141	0.920	36.8	78.5
60.0	2.570	0.998	1.1	2332.0		45.0	3.019	0.955	20.3	142.1
						50.0	2.907	0.987	7.5	382.6
						60.0	4.443	0.999	0.8	5545.6

x = 600mm, y = 50mm			Exp. DT2			Q_w = 23L/s		D = 46mm		x = 600mm, y = 75mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]		z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.934	0.052	109.0	1.4		5.0	2.570	0.062	127.0	1.3
10.0	2.962	0.058	104.1	1.7		10.0	2.636	0.085	158.3	1.4
15.0	2.962	0.065	98.2	1.9		15.0	2.880	0.092	157.5	1.7
20.0	3.049	0.056	71.6	2.4		20.0	2.962	0.137	186.8	2.2
23.0	3.141	0.030	35.8	2.7		22.0	3.240	0.135	168.2	2.6
25.0	3.206	0.051	45.9	3.6		24.0	3.206	0.183	188.2	3.1
26.0	3.240	0.098	83.8	3.8		25.0	3.240	0.192	140.4	4.4
27.0	3.206	0.137	67.6	6.5		26.0	3.309	0.246	131.1	6.2
28.0	2.990	0.275	58.3	14.1		27.0	3.309	0.368	157.1	7.7
29.0	3.019	0.377	88.0	12.9		28.0	3.274	0.479	131.3	11.9
30.0	3.206	0.525	64.7	26.0		29.0	3.240	0.522	144.4	11.7
31.0	3.141	0.615	83.1	23.2		30.0	3.240	0.685	107.7	20.6
32.0	3.110	0.805	38.3	65.4		31.0	3.274	0.711	115.7	20.1
33.0	3.240	0.834	37.8	71.5		32.0	3.240	0.803	91.9	28.3
34.0	3.206	0.930	24.2	123.2		33.0	3.206	0.815	92.8	28.2

35.0	3.274	0.933	22.1	138.2
36.0	3.110	0.973	11.6	260.8
37.0	3.344	0.955	20.5	155.8
38.0	3.274	0.951	26.4	118.0
40.0	3.141	0.993	4.1	760.7
45.0	2.990	0.996	3.5	850.7
55.0	3.141	0.999	0.9	3488.2

34.0	3.240	0.876	66.0	43.0
35.0	3.206	0.901	62.3	46.4
36.0	3.240	0.912	60.7	48.7
38.0	3.309	0.921	63.8	47.8
40.0	3.309	0.983	13.7	237.4
45.0	3.019	0.985	15.4	193.1
50.0	2.827	0.990	9.9	282.8
55.0	1.968	0.999	0.9	2185.2

x = 600mm, y = 100mm   Exp. DT2 Q_w = 23L/s D = 46mm x = 600mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.704	0.068	115.7	1.6
10.0	2.752	0.080	129.7	1.7
14.0	2.802	0.094	130.9	2.0
16.0	2.990	0.112	148.9	2.3
18.0	3.206	0.148	148.0	3.2
20.0	3.240	0.230	194.6	3.8
22.0	3.344	0.354	187.7	6.3
24.0	3.380	0.455	197.9	7.8
26.0	3.344	0.595	207.3	9.6
28.0	3.418	0.710	169.3	14.3
30.0	3.534	0.803	164.0	17.3
32.0	3.309	0.869	92.3	31.1
34.0	3.418	0.900	102.5	30.0
36.0	3.418	0.940	69.1	46.5
40.0	3.240	0.970	38.2	82.2
45.0	3.141	0.983	15.7	196.7
50.0	1.994	0.985	8.5	231.1
55.0	1.896	0.982	9.6	193.9
60.0	1.563	0.994	3.2	485.2
70.0	1.481	0.993	2.9	507.1

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.206	0.039	79.0	1.1
10.0	2.658	0.052	104.6	1.3
15.0	2.704	0.068	123.4	1.5
20.0	2.880	0.111	164.4	1.9
24.0	2.853	0.195	205.9	2.7
28.0	3.110	0.338	254.7	4.1
32.0	3.049	0.457	284.8	4.9
36.0	3.110	0.530	250.8	6.6
40.0	2.962	0.596	236.7	7.5
44.0	3.141	0.643	206.4	9.8
48.0	3.079	0.713	148.5	14.8
52.0	3.019	0.744	126.8	17.7
56.0	2.827	0.793	100.4	22.3
60.0	2.752	0.881	47.9	50.6
64.0	2.206	0.891	43.5	45.2
68.0	2.374	0.954	17.4	130.1
72.0	2.237	0.957	16.8	127.4
76.0	2.160	0.958	17.6	117.6
80.0	2.130	0.975	8.1	256.5
85.0	5.016	0.994	1.9	2625.4
90.0	1.335	0.997	1.4	950.4

x = 700mm, y = 0mm   Exp. DT2 Q_w = 23L/s D = 46mm x = 700mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.907	0.028	75.7	1.1
10.0	2.962	0.044	90.2	1.4
13.0	2.934	0.076	121.6	1.8
16.0	3.049	0.103	139.6	2.3
18.0	3.019	0.124	138.9	2.7
20.0	3.110	0.154	144.5	3.3
22.0	3.141	0.233	151.6	4.8

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.853	0.030	78.9	1.1
10.0	2.827	0.062	129.1	1.4
15.0	2.934	0.069	115.9	1.8
18.0	2.962	0.114	142.2	2.4
21.0	2.907	0.146	166.6	2.6
24.0	3.079	0.193	160.3	3.7
27.0	3.049	0.270	183.4	4.5

24.0	3.173	0.307	152.0	6.4	30.0	3.049	0.339	158.7	6.5
26.0	3.206	0.450	154.3	9.4	33.0	3.110	0.418	162.9	8.0
28.0	3.141	0.593	145.3	12.8	36.0	3.141	0.532	142.9	11.7
30.0	3.173	0.663	146.8	14.3	39.0	3.206	0.600	137.2	14.0
32.0	3.173	0.744	123.6	19.1	42.0	3.173	0.712	108.7	20.8
34.0	3.173	0.791	114.6	21.9	45.0	3.206	0.779	105.6	23.6
36.0	3.206	0.838	100.6	26.7	48.0	3.240	0.841	77.6	35.1
40.0	3.141	0.865	88.8	30.6	51.0	3.206	0.876	70.1	40.1
45.0	3.079	0.928	61.3	46.6	54.0	3.240	0.894	58.5	49.5
50.0	3.019	0.944	50.2	56.8	57.0	3.206	0.916	55.1	53.3
55.0	3.019	0.965	34.5	84.5	60.0	3.206	0.945	43.5	69.6
60.0	3.079	0.979	20.6	146.4	65.0	3.206	0.967	27.3	113.6
70.0	3.206	0.991	9.5	334.5	70.0	2.990	0.973	20.5	142.0
80.0	2.356	0.995	4.7	498.9	80.0	2.777	0.991	8.5	323.8
90.0	2.962	0.999	1.4	2114.1	90.0	2.827	0.997	2.7	1043.6
					100.0	3.141	0.999	1.3	2413.8

x = 700mm, y = 50mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 700mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.853	0.024	55.3	1.3	5.0	2.827	0.046	91.5	1.4
10.0	2.990	0.036	69.9	1.5	9.0	2.880	0.062	99.1	1.8
14.0	3.049	0.088	98.2	2.7	12.0	2.853	0.111	128.1	2.5
16.0	2.990	0.099	92.9	3.2	14.0	2.990	0.146	146.7	3.0
18.0	3.110	0.131	98.9	4.1	16.0	2.990	0.237	168.4	4.2
20.0	3.110	0.253	88.5	8.9	18.0	2.990	0.285	158.1	5.4
22.0	3.079	0.400	120.7	10.2	20.0	3.019	0.381	200.9	5.7
24.0	3.173	0.514	97.6	16.7	22.0	3.110	0.480	192.4	7.8
26.0	3.141	0.692	104.6	20.8	24.0	3.141	0.594	163.2	11.4
28.0	3.206	0.748	86.3	27.8	26.0	3.141	0.681	158.8	13.5
30.0	3.206	0.799	87.7	29.2	28.0	3.141	0.687	158.0	13.7
32.0	3.240	0.839	66.8	40.7	30.0	3.173	0.804	110.1	23.2
35.0	3.206	0.872	66.5	42.1	32.0	3.206	0.888	66.3	42.9
40.0	3.110	0.938	47.4	61.5	35.0	3.141	0.923	48.1	60.3
45.0	3.049	0.962	28.5	103.0	40.0	3.173	0.959	30.9	98.5
50.0	3.173	0.965	27.3	112.1	45.0	3.049	0.961	33.1	88.5
55.0	3.173	0.975	21.3	145.3	50.0	2.990	0.968	29.3	98.8
60.0	3.173	0.986	11.8	265.2	55.0	2.880	0.988	9.9	287.5
70.0	2.934	0.989	9.0	322.4	60.0	3.173	0.996	3.7	854.7
80.0	2.962	0.996	5.3	556.4	70.0	2.613	0.998	2.0	1304.3
90.0	2.990	0.996	3.1	961.2	80.0	2.934	0.999	1.4	2092.8

x = 700mm, y = 100mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 700mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.752	0.053	110.0	1.3	5.0	2.528	0.021	48.3	1.1
9.0	2.777	0.090	137.5	1.8	10.0	2.704	0.040	79.4	1.3
12.0	2.853	0.125	166.2	2.1	15.0	2.728	0.057	109.0	1.4
14.0	2.934	0.191	192.8	2.9	20.0	2.752	0.080	129.4	1.7
16.0	2.934	0.225	204.4	3.2	25.0	2.827	0.112	149.1	2.1
18.0	3.019	0.279	197.8	4.3	30.0	2.962	0.192	193.7	2.9
20.0	3.110	0.398	210.9	5.9	35.0	3.019	0.279	215.9	3.9
22.0	3.110	0.473	196.8	7.5	40.0	3.049	0.356	240.3	4.5
24.0	3.049	0.588	217.3	8.3	45.0	3.049	0.459	229.7	6.1
26.0	3.141	0.607	192.5	9.9	50.0	3.049	0.538	213.3	7.7
28.0	3.110	0.677	192.6	10.9	55.0	2.990	0.631	191.2	9.9
30.0	3.141	0.727	163.0	14.0	60.0	2.880	0.637	166.5	11.0
32.0	3.173	0.787	144.6	17.3	65.0	2.853	0.695	138.4	14.3
34.0	3.141	0.835	114.5	22.9	70.0	2.777	0.746	115.7	17.9
36.0	3.141	0.859	106.8	25.3	75.0	2.508	0.821	74.6	27.6
40.0	3.049	0.904	73.1	37.7	80.0	2.392	0.929	32.6	68.2
45.0	2.962	0.942	51.0	54.7	85.0	2.321	0.937	27.8	78.2
50.0	2.853	0.957	34.6	78.9	90.0	2.130	0.952	23.3	87.1
55.0	2.752	0.972	19.5	137.2	95.0	2.221	0.984	6.9	316.7
60.0	2.488	0.970	20.3	118.9	100.0	1.994	0.993	5.1	388.0
70.0	2.221	0.975	12.8	169.2	105.0	1.968	0.997	2.1	934.9
80.0	1.981	0.985	9.1	214.5					
90.0	1.968	0.989	4.7	414.4					
100.0	1.944	0.999	0.9	2156.9					

x = 800mm, y = 0mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 800mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.802	0.027	56.0	1.3	5.0	2.704	0.024	55.6	1.2
9.0	2.962	0.052	82.6	1.9	9.0	2.853	0.041	73.6	1.6
12.0	2.962	0.120	108.7	3.3	12.0	2.907	0.073	102.2	2.1
15.0	3.019	0.219	132.1	5.0	15.0	2.934	0.112	111.3	3.0
18.0	3.141	0.342	142.9	7.5	18.0	2.934	0.158	133.1	3.5
21.0	3.173	0.508	163.4	9.9	21.0	3.049	0.223	147.6	4.6
24.0	3.141	0.628	153.0	12.9	24.0	3.110	0.319	160.1	6.2
27.0	3.173	0.647	159.2	12.9	27.0	3.110	0.355	159.1	6.9
30.0	3.206	0.727	139.1	16.8	30.0	3.141	0.447	173.7	8.1
33.0	3.173	0.766	136.4	17.8	33.0	3.206	0.527	169.7	10.0
36.0	3.173	0.793	132.4	19.0	36.0	3.206	0.576	164.4	11.2
39.0	3.141	0.857	99.9	26.9	39.0	3.240	0.653	142.5	14.8
42.0	3.110	0.866	98.8	27.3	42.0	3.173	0.696	147.3	15.0
45.0	3.079	0.906	74.7	37.3	45.0	3.206	0.751	123.6	19.5
50.0	3.049	0.931	64.2	44.2	50.0	3.173	0.823	113.6	23.0

55.0	3.019	0.946	49.8	57.4
60.0	2.990	0.954	45.1	63.3
70.0	2.934	0.976	20.9	137.0
80.0	2.880	0.988	12.8	222.3
95.0	2.658	0.996	5.0	529.3
110.0	2.549	0.999	2.0	1272.9

55.0	3.206	0.883	72.0	39.3
60.0	3.141	0.909	63.5	45.0
65.0	3.141	0.930	52.0	56.2
70.0	3.173	0.953	40.0	75.6
80.0	2.934	0.978	20.6	139.3
95.0	2.752	0.992	8.7	313.7
110.0	2.468	0.995	3.8	646.6

x = 800mm, y = 50mm Exp. DT2 Q_w = 23L/s D = 46mm x = 800mm, y = 75mm

x = 800mm, *y* = 50mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.728	0.039	65.3	1.6
9.0	2.827	0.059	74.5	2.2
12.0	2.962	0.093	89.3	3.1
15.0	3.110	0.195	113.9	5.3
18.0	3.206	0.342	132.6	8.3
21.0	3.206	0.552	146.5	12.1
24.0	3.206	0.543	142.0	12.3
27.0	3.240	0.656	138.6	15.3
30.0	3.274	0.741	123.8	19.6
33.0	3.206	0.812	115.4	22.6
36.0	3.274	0.808	108.3	24.4
39.0	3.206	0.850	94.5	28.8
42.0	3.274	0.855	90.1	31.1
45.0	3.173	0.898	74.6	38.2
50.0	3.240	0.910	65.8	44.8
55.0	3.240	0.925	56.2	53.3
60.0	3.173	0.948	42.4	71.0
65.0	3.079	0.952	38.5	76.1
70.0	3.079	0.970	25.8	115.7
80.0	3.019	0.982	15.4	192.5
95.0	2.853	0.992	7.8	362.8
110.0	2.752	0.997	2.6	1055.4

x = 800mm, *y* = 75mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.853	0.058	79.3	2.1
8.0	2.704	0.129	121.0	2.9
10.0	2.934	0.204	156.3	3.8
12.0	2.990	0.264	156.7	5.0
14.0	3.049	0.324	159.4	6.2
16.0	3.049	0.460	170.2	8.2
18.0	3.079	0.513	159.1	9.9
20.0	3.049	0.573	166.7	10.5
22.0	3.110	0.683	154.8	13.7
24.0	3.079	0.686	147.8	14.3
26.0	3.079	0.727	138.1	16.2
28.0	3.110	0.850	97.1	27.2
30.0	3.110	0.846	94.7	27.8
32.0	3.110	0.894	72.8	38.2
35.0	3.079	0.903	74.3	37.4
40.0	3.079	0.940	47.6	60.8
45.0	3.019	0.925	59.9	46.6
50.0	2.990	0.957	37.7	75.9
55.0	3.019	0.965	31.4	92.8
60.0	2.962	0.973	23.5	122.6
70.0	2.752	0.985	13.5	200.8
85.0	2.853	0.995	5.6	506.9
100.0	2.704	0.997	2.4	1123.8

x = 800mm, y = 100mm Exp. DT2 Q_w = 23L/s D = 46mm x = 800mm, y = 120mm

x = 800mm, *y* = 100mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.549	0.047	86.8	1.4
9.0	2.777	0.064	104.5	1.7
12.0	2.728	0.111	132.8	2.3
15.0	2.934	0.181	159.9	3.3
18.0	2.934	0.254	178.0	4.2
21.0	2.962	0.341	202.2	5.0

x = 800mm, *y* = 120mm:

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.374	0.015	35.6	1.0
10.0	2.613	0.034	68.4	1.3
15.0	2.592	0.060	111.1	1.4
20.0	2.636	0.082	122.7	1.8
25.0	2.658	0.095	139.7	1.8
30.0	2.704	0.122	146.3	2.3

24.0	2.990	0.384	208.7	5.5	35.0	2.802	0.199	179.0	3.1
27.0	2.934	0.493	208.5	6.9	40.0	2.802	0.227	189.0	3.4
30.0	2.990	0.565	196.5	8.6	45.0	2.802	0.326	210.4	4.3
33.0	3.019	0.668	160.3	12.6	50.0	2.827	0.396	214.2	5.2
36.0	2.990	0.752	137.8	16.3	55.0	2.777	0.454	205.0	6.2
39.0	3.019	0.803	121.2	20.0	60.0	2.658	0.497	183.0	7.2
42.0	2.934	0.851	98.4	25.4	65.0	2.528	0.523	166.5	7.9
45.0	2.907	0.873	80.3	31.6	70.0	2.528	0.576	149.9	9.7
50.0	2.827	0.913	58.9	43.8	75.0	2.528	0.729	104.0	17.7
55.0	2.752	0.919	54.3	46.6	80.0	2.508	0.773	92.7	20.9
60.0	2.658	0.919	54.0	45.2	85.0	2.374	0.852	56.6	35.7
65.0	2.570	0.933	44.1	54.4	90.0	2.338	0.914	34.7	61.6
70.0	2.508	0.943	35.0	67.6	95.0	2.287	0.957	20.8	105.2
80.0	2.392	0.960	24.5	93.8	100.0	2.356	0.982	9.1	254.2
95.0	2.356	0.988	6.6	352.9	110.0	2.411	0.992	4.1	583.5
110.0	2.237	0.996	2.9	768.8	120.0	2.488	0.999	0.6	4142.4

x = 1000mm, y = 0mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 1000mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.549	0.014	28.5	1.2	5.0	2.728	0.016	34.5	1.3
10.0	2.752	0.052	66.9	2.1	10.0	2.752	0.027	52.2	1.4
12.0	2.827	0.091	90.5	2.9	12.0	2.728	0.036	64.0	1.6
14.0	2.962	0.151	115.1	3.9	14.0	2.728	0.063	84.6	2.0
16.0	3.019	0.288	145.9	6.0	16.0	2.777	0.102	113.3	2.5
18.0	3.079	0.299	146.8	6.3	18.0	2.907	0.154	123.1	3.6
20.0	3.019	0.437	146.5	9.0	20.0	3.019	0.187	123.5	4.6
22.0	3.079	0.570	134.7	13.0	22.0	3.019	0.283	143.9	5.9
24.0	3.079	0.653	129.9	15.5	24.0	3.049	0.384	143.6	8.2
26.0	3.079	0.748	104.6	22.0	26.0	3.110	0.526	152.3	10.7
28.0	3.079	0.804	92.5	26.8	28.0	3.141	0.599	136.0	13.8
30.0	3.079	0.842	86.9	29.8	30.0	3.110	0.707	123.5	17.8
32.0	3.049	0.889	65.1	41.6	32.0	3.141	0.764	113.2	21.2
34.0	3.049	0.925	57.4	49.1	34.0	3.141	0.815	94.3	27.2
36.0	3.079	0.933	46.9	61.3	36.0	3.173	0.843	83.7	32.0
38.0	3.049	0.940	44.1	65.0	38.0	3.110	0.886	75.4	36.5
40.0	2.990	0.950	36.6	77.6	40.0	3.173	0.885	74.0	38.0
42.0	2.962	0.953	38.4	73.5	42.0	3.079	0.906	63.2	44.1
45.0	2.990	0.959	32.4	88.5	45.0	3.141	0.919	50.3	57.4
50.0	2.962	0.964	33.2	86.0	50.0	3.141	0.945	39.5	75.2
60.0	3.019	0.978	17.9	164.9	60.0	3.079	0.971	23.9	125.1
75.0	3.019	0.992	7.9	379.1	75.0	2.990	0.987	10.5	281.0
90.0	2.880	0.997	2.6	1104.2	90.0	2.907	0.995	4.3	672.7

x = 1000mm, y = 50mm	Exp. DT2	Q_w = 23L/s	D = 46mm	x = 1000mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.636	0.013	28.5	1.2	5.0	2.636	0.012	25.6	1.2
10.0	2.827	0.031	58.9	1.5	10.0	2.681	0.031	54.5	1.5
12.0	2.880	0.049	74.6	1.9	12.0	2.728	0.043	73.9	1.6
14.0	2.853	0.104	114.6	2.6	14.0	2.704	0.077	112.8	1.9
16.0	2.934	0.158	132.9	3.5	16.0	2.777	0.081	106.5	2.1
18.0	3.079	0.230	152.4	4.6	18.0	2.777	0.139	153.5	2.5
20.0	3.079	0.308	161.9	5.9	20.0	2.827	0.196	169.8	3.3
22.0	3.141	0.397	158.4	7.9	22.0	2.827	0.269	184.6	4.1
24.0	3.141	0.531	172.7	9.7	24.0	2.907	0.354	212.9	4.8
26.0	3.173	0.634	147.6	13.6	26.0	2.934	0.460	222.9	6.1
28.0	3.206	0.685	138.7	15.8	28.0	2.962	0.556	205.9	8.0
30.0	3.206	0.773	125.4	19.8	30.0	3.019	0.570	209.8	8.2
32.0	3.173	0.795	108.1	23.3	32.0	2.962	0.697	196.6	10.5
34.0	3.206	0.844	89.5	30.2	34.0	2.962	0.765	155.3	14.6
36.0	3.206	0.850	88.8	30.7	36.0	2.962	0.813	144.6	16.7
38.0	3.206	0.895	65.2	44.0	38.0	3.019	0.852	116.1	22.2
40.0	3.173	0.903	65.9	43.5	40.0	2.990	0.874	101.1	25.9
42.0	3.240	0.909	63.5	46.4	42.0	3.110	0.911	72.4	39.1
45.0	3.173	0.922	53.7	54.5	45.0	2.990	0.925	62.8	44.1
50.0	3.079	0.947	39.0	74.8	50.0	2.990	0.949	43.0	66.0
60.0	3.049	0.964	28.1	104.6	60.0	2.962	0.971	22.4	128.4
75.0	3.079	0.984	12.3	246.4	75.0	2.853	0.984	13.2	212.7
90.0	3.019	0.994	6.3	476.3	90.0	2.827	0.995	4.7	598.5

x = 1000mm, y = 100mm	Exp. DT2	Q_w = 23L/s	D = 46mm	x = 1000mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.468	0.009	18.5	1.2	5.0	2.019	0.005	11.0	0.8
10.0	2.488	0.017	33.4	1.2	10.0	2.392	0.013	29.2	1.0
15.0	2.592	0.041	69.8	1.5	15.0	2.430	0.024	48.4	1.2
20.0	2.592	0.061	95.2	1.7	20.0	2.430	0.028	53.9	1.3
24.0	2.570	0.086	116.5	1.9	25.0	2.392	0.027	47.5	1.4
27.0	2.549	0.111	131.9	2.1	30.0	2.206	0.028	44.1	1.4
30.0	2.570	0.171	164.9	2.7	33.0	2.190	0.034	45.1	1.7
33.0	2.570	0.253	194.3	3.4	36.0	2.190	0.040	51.3	1.7
36.0	2.592	0.329	203.3	4.2	39.0	2.116	0.083	77.5	2.3
39.0	2.636	0.424	221.9	5.0	42.0	2.160	0.104	86.9	2.6
42.0	2.728	0.539	229.8	6.4	45.0	2.270	0.220	124.1	4.0
45.0	2.658	0.626	209.1	8.0	48.0	2.356	0.327	136.5	5.7
48.0	2.704	0.706	160.9	11.9	51.0	2.411	0.453	141.0	7.7
51.0	2.704	0.778	132.3	15.9	54.0	2.528	0.604	124.0	12.3
54.0	2.728	0.817	103.3	21.6	57.0	2.613	0.707	100.0	18.5

57.0	2.681	0.882	69.0	34.3	60.0	2.658	0.793	85.2	24.7
60.0	2.704	0.906	56.1	43.7	63.0	2.613	0.827	72.1	30.0
65.0	2.728	0.934	37.9	67.2	66.0	2.592	0.841	66.2	32.9
70.0	2.752	0.952	27.2	96.3	70.0	2.681	0.900	44.4	54.3
75.0	2.681	0.972	16.9	154.2	75.0	2.777	0.953	24.5	108.0
80.0	2.752	0.979	12.6	213.7	80.0	2.613	0.962	19.8	127.0
90.0	2.728	0.989	7.5	359.6	90.0	2.681	0.987	7.9	335.0
100.0	2.880	0.996	2.7	1062.5	100.0	2.752	0.997	3.3	831.3

x = 1200mm, y = 0mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 1200mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.549	0.003	7.7	1.0	5.0	2.728	0.002	6.1	1.0
10.0	2.570	0.011	21.8	1.3	10.0	2.681	0.012	22.3	1.5
12.0	2.704	0.029	42.0	1.9	12.0	2.549	0.018	31.0	1.5
14.0	2.681	0.047	61.0	2.1	14.0	2.728	0.042	54.7	2.1
16.0	2.880	0.141	106.8	3.8	16.0	2.728	0.078	82.1	2.6
17.0	2.990	0.194	125.7	4.6	17.0	2.907	0.111	97.7	3.3
18.0	2.990	0.282	153.9	5.5	18.0	2.990	0.148	116.7	3.8
19.0	3.079	0.400	188.1	6.5	19.0	3.049	0.237	143.0	5.1
20.0	3.079	0.478	175.2	8.4	20.0	3.019	0.299	158.2	5.7
21.0	3.079	0.518	177.4	9.0	21.0	3.110	0.351	182.9	6.0
22.0	3.141	0.645	173.0	11.7	22.0	3.110	0.476	174.4	8.5
23.0	3.110	0.766	153.1	15.6	23.0	3.110	0.583	175.0	10.4
24.0	3.173	0.812	131.5	19.6	24.0	3.079	0.645	161.6	12.3
25.0	3.141	0.841	114.9	23.0	25.0	3.079	0.727	158.6	14.1
26.0	3.110	0.877	104.1	26.2	26.0	3.110	0.801	129.4	19.2
28.0	3.049	0.932	64.4	44.1	27.0	3.141	0.839	113.2	23.3
30.0	3.141	0.961	41.4	72.9	28.0	3.110	0.880	98.5	27.8
32.0	3.173	0.965	37.3	82.1	30.0	3.110	0.941	62.7	46.7
35.0	3.274	0.982	21.0	153.2	32.0	3.110	0.960	46.0	64.9
40.0	2.853	0.994	6.7	423.2	35.0	3.019	0.969	35.8	81.8
50.0	3.049	0.998	1.4	2174.5	40.0	3.110	0.986	14.1	217.5
60.0	2.990	0.999	0.9	3319.9	50.0	3.240	0.997	3.0	1076.3
					60.0	3.049	0.998	2.2	1382.6

x = 1200mm, y = 50mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 1200mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.658	0.004	9.2	1.1	5.0	2.592	0.003	5.9	1.1
10.0	2.777	0.015	31.0	1.3	10.0	2.613	0.009	18.6	1.3
15.0	2.827	0.037	64.1	1.7	15.0	2.681	0.026	45.8	1.5
18.0	2.777	0.097	118.2	2.3	18.0	2.636	0.039	65.7	1.6
20.0	2.880	0.144	142.1	2.9	21.0	2.658	0.048	79.9	1.6

22.0	2.990	0.227	180.4	3.8	24.0	2.613	0.061	90.8	1.8
24.0	2.990	0.333	217.5	4.6	27.0	2.592	0.084	113.5	1.9
26.0	2.990	0.382	223.3	5.1	30.0	2.658	0.120	138.9	2.3
28.0	2.962	0.523	227.6	6.8	32.0	2.636	0.144	140.2	2.7
30.0	2.990	0.597	215.3	8.3	34.0	2.704	0.206	171.4	3.3
32.0	2.934	0.580	230.0	7.4	36.0	2.728	0.276	190.3	4.0
34.0	2.934	0.658	210.7	9.2	38.0	2.728	0.359	206.3	4.7
36.0	2.907	0.682	209.3	9.5	40.0	2.752	0.464	233.0	5.5
38.0	2.853	0.742	200.4	10.6	42.0	2.777	0.599	203.3	8.2
40.0	2.880	0.806	162.4	14.3	44.0	2.777	0.704	192.4	10.2
42.0	2.907	0.843	139.4	17.6	46.0	2.827	0.765	164.9	13.1
44.0	2.934	0.896	95.2	27.6	48.0	2.802	0.858	117.9	20.4
46.0	2.880	0.915	85.7	30.8	50.0	2.827	0.869	104.6	23.5
48.0	2.907	0.930	73.7	36.7	52.0	2.853	0.897	86.4	29.6
50.0	2.934	0.960	42.4	66.5	54.0	2.880	0.928	62.9	42.5
52.0	2.853	0.973	32.3	86.0	57.0	2.880	0.968	32.3	86.3
55.0	2.934	0.982	23.2	124.2	60.0	2.853	0.989	13.2	213.7
60.0	2.907	0.988	12.4	231.6	65.0	2.827	0.993	7.2	389.9
70.0	3.456	0.998	1.6	2155.9	70.0	3.049	0.997	3.6	844.5

x = 1200mm, y = 100mm		Exp. DT2		Q_w = 23L/s		D = 46mm		x = 1200mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.468	0.005	10.3	1.2	5.0	2.130	0.004	9.2	1.0
15.0	2.488	0.011	22.6	1.2	10.0	2.270	0.010	19.2	1.2
20.0	2.488	0.026	44.5	1.4	15.0	2.101	0.017	30.6	1.2
25.0	2.508	0.044	65.4	1.7	20.0	2.101	0.031	47.2	1.4
28.0	2.468	0.061	78.1	1.9	24.0	2.221	0.065	72.9	2.0
30.0	2.528	0.097	112.1	2.2	26.0	2.190	0.096	96.4	2.2
32.0	2.528	0.103	112.9	2.3	28.0	2.254	0.117	101.6	2.6
34.0	2.570	0.161	129.4	3.2	30.0	2.411	0.165	126.2	3.2
36.0	2.681	0.240	153.4	4.2	32.0	2.411	0.240	141.2	4.1
38.0	2.704	0.392	167.3	6.3	34.0	2.430	0.344	167.6	5.0
40.0	2.752	0.507	171.8	8.1	36.0	2.508	0.465	170.4	6.8
42.0	2.728	0.669	147.6	12.4	38.0	2.488	0.656	167.7	9.7
44.0	2.752	0.752	131.3	15.8	40.0	2.528	0.731	140.6	13.1
46.0	2.777	0.856	86.0	27.6	42.0	2.549	0.821	112.3	18.6
48.0	2.802	0.937	43.8	59.9	44.0	2.592	0.917	64.9	36.6
50.0	2.934	0.965	29.9	94.7	46.0	2.636	0.942	51.0	48.7
52.0	2.907	0.979	17.4	163.5	48.0	2.704	0.977	24.0	110.1
55.0	2.990	0.990	11.9	248.7	50.0	2.613	0.982	16.4	156.5
60.0	3.049	0.997	2.4	1266.3	52.0	2.802	0.986	12.4	222.9
70.0	3.019	0.999	1.8	1675.1	55.0	3.456	0.997	4.6	748.6

x = 1400mm, y = 0mm	Exp. DT2	Q_w = 23L/s	D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.658	0.003	5.4	1.4
15.0	2.613	0.011	17.5	1.6
18.0	2.681	0.033	43.2	2.0
20.0	2.728	0.069	80.0	2.4
22.0	2.658	0.113	120.8	2.5
24.0	2.777	0.191	173.9	3.0
26.0	2.827	0.219	195.3	3.2
28.0	2.827	0.301	239.4	3.6
30.0	2.962	0.340	248.0	4.1
32.0	2.962	0.425	262.2	4.8
34.0	3.019	0.464	262.5	5.3
36.0	3.019	0.541	266.2	6.1
38.0	3.110	0.618	253.0	7.6
40.0	2.990	0.677	226.9	8.9
42.0	3.019	0.769	185.1	12.5
44.0	3.049	0.839	155.8	16.4
46.0	3.079	0.867	126.2	21.1
48.0	3.141	0.923	80.1	36.2
50.0	3.141	0.946	55.8	53.2
52.0	3.019	0.966	39.4	74.1
55.0	2.827	0.982	21.2	131.0
60.0	2.990	0.996	5.7	522.5
70.0	3.840	1.000	0.6	6397.5

x = 1400mm, y = 25mm				
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.752	0.004	7.8	1.4
15.0	2.681	0.024	34.5	1.8
18.0	2.636	0.045	63.7	1.8
20.0	2.592	0.090	102.3	2.3
22.0	2.681	0.138	139.8	2.6
24.0	2.704	0.214	180.7	3.2
26.0	2.728	0.271	236.9	3.1
28.0	2.752	0.320	235.3	3.7
30.0	2.777	0.427	261.6	4.5
32.0	2.777	0.447	267.8	4.6
34.0	2.907	0.596	266.1	6.5
36.0	2.880	0.634	258.3	7.1
38.0	2.934	0.730	215.0	10.0
40.0	2.907	0.809	186.2	12.6
42.0	2.934	0.821	173.7	13.9
44.0	2.962	0.880	132.8	19.6
46.0	2.962	0.912	103.0	26.2
48.0	2.934	0.943	71.5	38.7
50.0	2.934	0.964	46.3	61.1
52.0	3.019	0.982	24.5	121.0
55.0	3.019	0.981	25.7	115.2
60.0	2.907	0.996	3.7	782.8
70.0	3.274	0.999	1.1	2972.6

x = 1400mm, y = 50mm	Exp. DT2	Q_w = 23L/s	D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.704	0.006	11.9	1.3
15.0	2.704	0.022	39.7	1.5
18.0	2.658	0.042	64.9	1.7
20.0	2.636	0.045	71.5	1.7
22.0	2.613	0.060	90.3	1.7
24.0	2.636	0.077	104.6	2.0
26.0	2.613	0.104	122.2	2.2
28.0	2.658	0.143	139.4	2.7
30.0	2.752	0.201	161.1	3.4
32.0	2.802	0.319	189.6	4.7
34.0	2.880	0.472	199.6	6.8
36.0	2.853	0.563	201.8	8.0
38.0	2.907	0.655	175.2	10.9
40.0	2.907	0.761	139.3	15.9
42.0	2.934	0.856	96.9	25.9
44.0	2.934	0.915	64.2	41.8

x = 1400mm, y = 75mm				
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.658	0.003	6.1	1.2
15.0	2.592	0.008	15.6	1.4
20.0	2.570	0.021	33.4	1.6
24.0	2.549	0.033	51.2	1.7
26.0	2.549	0.061	72.9	2.1
28.0	2.528	0.068	75.9	2.3
30.0	2.728	0.149	119.1	3.4
31.0	2.777	0.198	141.6	3.9
32.0	2.777	0.245	149.0	4.6
33.0	2.827	0.358	172.0	5.9
34.0	2.853	0.420	172.4	7.0
35.0	2.853	0.576	170.5	9.6
36.0	2.880	0.632	169.3	10.8
37.0	2.853	0.679	143.1	13.5
38.0	2.907	0.771	122.3	18.3
39.0	2.907	0.815	103.5	22.9

46.0	2.934	0.936	49.9	55.1	40.0	2.853	0.888	76.1	33.3
48.0	2.962	0.963	32.4	88.0	42.0	2.934	0.922	51.3	52.7
50.0	2.907	0.983	16.7	171.1	44.0	2.934	0.971	24.2	117.7
52.0	2.962	0.987	11.9	245.6	46.0	2.907	0.985	11.4	251.2
55.0	3.019	0.986	12.3	242.1	50.0	2.962	0.994	5.0	588.6
60.0	3.079	0.998	1.9	1618.2	60.0	3.456	0.999	1.1	3138.8
70.0	2.704	1.000	0.8	3378.9					

x = 1400mm, y = 100mm		Exp. DT2	Q_w = 23L/s			D = 46mm		x = 1400mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.356	0.003	5.7	1.2	10.0	1.932	0.006	9.2	1.3
15.0	2.392	0.010	18.4	1.3	15.0	2.046	0.017	24.8	1.4
20.0	2.488	0.024	36.3	1.6	20.0	2.160	0.041	52.3	1.7
24.0	2.488	0.038	48.3	1.9	24.0	2.221	0.084	90.6	2.1
26.0	2.430	0.062	72.5	2.1	26.0	2.254	0.130	112.4	2.6
28.0	2.570	0.102	87.9	3.0	27.0	2.175	0.137	110.6	2.7
29.0	2.613	0.146	101.5	3.8	28.0	2.237	0.202	139.4	3.2
30.0	2.681	0.255	144.4	4.7	29.0	2.206	0.206	139.9	3.3
31.0	2.728	0.263	129.7	5.5	30.0	2.221	0.301	167.6	4.0
32.0	2.777	0.357	144.9	6.8	31.0	2.287	0.389	182.5	4.9
33.0	2.802	0.478	161.7	8.3	32.0	2.304	0.399	172.4	5.3
34.0	2.827	0.588	131.0	12.7	33.0	2.270	0.508	182.9	6.3
35.0	2.853	0.663	126.1	15.0	34.0	2.321	0.566	193.8	6.8
36.0	2.827	0.695	122.9	16.0	35.0	2.254	0.653	165.3	8.9
37.0	2.853	0.845	92.8	26.0	36.0	2.374	0.740	146.9	12.0
38.0	2.802	0.871	74.0	33.0	37.0	2.430	0.828	115.4	17.4
39.0	2.827	0.904	57.1	44.8	38.0	2.338	0.796	121.6	15.3
40.0	2.880	0.943	38.2	71.1	39.0	2.392	0.876	82.4	25.4
42.0	2.907	0.983	13.2	216.5	40.0	2.411	0.903	80.2	27.2
45.0	2.853	0.996	4.8	592.2	42.0	2.488	0.950	44.5	53.1
50.0	3.659	0.999	0.4	9139.7	45.0	2.549	0.972	22.8	108.7
					50.0	1.672	0.999	1.1	1518.9

x = 1800mm, y = 0mm		Exp. DT2	Q_w = 23L/s			D = 46mm		x = 1800mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
20.0	2.592	0.009	14.7	1.6	15.0	2.528	0.004	6.4	1.4
25.0	2.592	0.017	27.2	1.6	20.0	2.613	0.010	16.5	1.5
28.0	2.613	0.020	29.5	1.7	25.0	2.636	0.025	35.2	1.9
30.0	2.570	0.031	41.6	1.9	28.0	2.636	0.049	67.8	1.9
32.0	2.613	0.050	63.9	2.1	30.0	2.613	0.059	80.3	1.9
34.0	2.658	0.092	99.1	2.5	32.0	2.704	0.096	118.3	2.2
35.0	2.853	0.135	116.6	3.3	34.0	2.802	0.155	167.1	2.6
36.0	2.853	0.165	134.8	3.5	35.0	2.802	0.186	191.2	2.7

37.0	2.907	0.233	172.3	3.9
38.0	2.934	0.293	185.2	4.6
39.0	2.962	0.394	196.5	5.9
40.0	2.962	0.493	215.6	6.8
41.0	2.962	0.599	231.1	7.7
42.0	2.990	0.619	201.1	9.2
43.0	2.962	0.719	202.3	10.5
44.0	2.990	0.764	179.8	12.7
45.0	2.962	0.849	130.5	19.3
46.0	2.990	0.890	107.4	24.8
48.0	2.990	0.934	73.5	38.0
50.0	2.990	0.971	37.9	76.6
52.0	2.962	0.973	34.6	83.3
55.0	2.962	0.988	14.2	206.1
60.0	3.141	0.998	3.6	870.8

36.0	2.827	0.229	212.3	3.0
37.0	2.880	0.265	222.4	3.4
38.0	2.934	0.355	257.1	4.1
39.0	2.962	0.437	277.7	4.7
40.0	2.962	0.496	280.9	5.2
41.0	2.990	0.561	277.8	6.0
42.0	2.990	0.636	253.9	7.5
43.0	2.990	0.687	232.3	8.8
44.0	2.990	0.763	206.3	11.1
45.0	3.019	0.807	181.7	13.4
46.0	3.049	0.868	137.9	19.2
48.0	3.019	0.914	101.4	27.2
50.0	3.019	0.944	60.0	47.5
52.0	3.079	0.965	41.0	72.5
55.0	3.079	0.981	20.6	146.7
60.0	3.079	0.994	7.4	413.7
65.0	2.934	0.998	2.9	1009.9

x = 1800mm, y = 50mm   Exp. DT2 Q_w = 23L/s D = 46mm x = 1800mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
15.0	2.592	0.002	3.4	1.4
20.0	2.549	0.006	10.9	1.3
25.0	2.508	0.030	37.5	2.0
28.0	2.658	0.077	87.7	2.3
30.0	2.777	0.144	148.3	2.7
31.0	2.704	0.180	180.7	2.7
32.0	2.827	0.225	191.0	3.3
33.0	2.880	0.315	246.3	3.7
34.0	2.907	0.365	274.0	3.9
35.0	2.990	0.420	290.6	4.3
36.0	2.990	0.517	315.2	4.9
37.0	2.990	0.574	329.7	5.2
38.0	3.049	0.642	321.0	6.1
39.0	3.019	0.696	280.4	7.5
40.0	3.019	0.746	281.6	8.0
41.0	3.049	0.792	252.4	9.6
42.0	3.049	0.831	226.5	11.2
43.0	3.110	0.859	186.4	14.3
44.0	3.110	0.889	158.7	17.4
45.0	3.079	0.906	136.2	20.5
47.0	3.049	0.951	73.7	39.4
50.0	3.079	0.983	32.3	93.7
55.0	3.019	0.995	7.8	385.1
65.0	3.206	0.999	1.2	2669.1

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
20.0	2.570	0.003	4.0	1.8
25.0	2.613	0.025	25.8	2.5
27.0	2.681	0.050	34.4	3.9
28.0	2.907	0.131	84.8	4.5
29.0	2.704	0.143	100.5	3.9
30.0	2.880	0.265	159.7	4.8
31.0	2.880	0.363	179.3	5.8
32.0	2.962	0.464	214.5	6.4
33.0	2.962	0.618	232.9	7.9
34.0	2.962	0.651	251.1	7.7
35.0	2.990	0.703	266.7	7.9
36.0	2.990	0.776	234.3	9.9
37.0	2.990	0.802	232.9	10.3
38.0	3.049	0.858	205.0	12.8
39.0	3.049	0.879	191.3	14.0
40.0	3.049	0.908	152.7	18.1
41.0	3.019	0.938	114.1	24.8
42.0	3.019	0.956	87.3	33.1
44.0	3.173	0.974	56.7	54.5
46.0	3.049	0.981	37.4	80.0
50.0	3.380	0.998	5.6	602.3
55.0	3.344	0.999	0.6	5570.3
60.0	3.418	0.999	0.8	4268.7

x = 1800mm, y = 100mm		Exp. DT2		Q_w = 23L/s	D = 46mm		x = 1800mm, y = 120mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
15.0	2.430	0.001	2.6	1.0	15.0	2.046	0.007	10.5	1.3
20.0	2.356	0.002	3.1	1.4	20.0	1.994	0.016	21.9	1.4
25.0	2.508	0.031	30.3	2.6	25.0	2.087	0.057	55.7	2.1
27.0	2.592	0.087	64.2	3.5	27.0	2.046	0.140	87.7	3.3
28.0	2.658	0.112	76.6	3.9	28.0	2.116	0.215	118.8	3.8
29.0	2.728	0.177	109.8	4.4	29.0	2.175	0.248	125.8	4.3
30.0	2.752	0.384	173.0	6.1	30.0	2.116	0.316	163.5	4.1
31.0	2.777	0.465	187.5	6.9	31.0	2.160	0.422	160.3	5.7
32.0	2.752	0.575	201.6	7.9	32.0	2.206	0.537	163.2	7.3
33.0	2.777	0.623	205.1	8.4	33.0	2.175	0.612	170.3	7.8
34.0	2.802	0.717	173.4	11.6	34.0	2.206	0.640	166.8	8.5
35.0	2.827	0.791	160.2	14.0	35.0	2.206	0.750	133.9	12.3
36.0	2.853	0.894	117.4	21.7	36.0	2.254	0.767	147.0	11.8
37.0	2.853	0.913	98.8	26.4	37.0	2.270	0.845	116.9	16.4
38.0	2.853	0.959	66.0	41.5	38.0	2.287	0.893	90.2	22.6
39.0	2.880	0.969	48.4	57.7	39.0	2.321	0.914	68.8	30.8
40.0	2.853	0.975	41.8	66.6	40.0	2.430	0.967	35.4	66.4
41.0	2.853	0.975	42.1	66.1	41.0	2.374	0.955	43.2	52.5
43.0	2.934	0.990	21.2	137.1	43.0	2.570	0.992	9.9	257.6
45.0	3.049	0.996	9.4	322.9	45.0	2.658	0.995	10.3	256.8

Table I-5 Double-tip conductivity probe data: Experiment DT3

x = -150mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
27.50	5.016	0.034	22.7	7.5	2	14.1	675.5
28.00	1.681	0.037	20.0	3.1	4	16.1	678.4
28.50	4.147	0.094	58.7	6.6	6	15.8	706.3
29.00	3.937	0.294	90.0	12.9	8	14.4	844.2
29.50	2.752	0.416	92.6	12.4	10	12.3	931.4
30.00	3.380	0.597	120.8	16.7	12	11.0	962.1
30.50	3.079	0.861	59.3	44.7	14	9.5	966.6
31.00	2.962	0.916	38.6	70.3	16	9.2	967.6
31.50	4.092	0.979	14.2	282.2	18	7.1	967.2
32.00	3.456	0.988	8.0	426.9	20	6.5	965.1
					22	4.9	966.1
					24	3.9	963.7
					26	2.8	963.6
					28	15.8	957.2
					30	11.3	949.7

x = -150mm, y = 25mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
29.50	1.932	0.032	8.7	7.1	2	45.9	736.9
30.00	2.907	0.147	34.7	12.3	4	48.2	736.9
30.50	3.575	0.203	50.5	14.3	6	43.5	894.3
31.00	2.962	0.264	68.3	11.4	8	44.5	957.5
31.50	3.494	0.523	82.6	22.1	10	44.7	967.3
32.00	3.418	0.867	48.9	60.6	12	40.1	968.3
32.50	3.702	0.965	18.3	195.2	14	38.9	968.2
33.00	3.418	0.996	3.6	945.3	16	38.6	967.3
33.50	4.319	1.000	0.4	10796.5	18	35.5	967.6
34.00	5.016	1.000	0.3	16720.0	20	35.3	967.3
					22	33.0	965.2
					24	29.0	965.4
					26	23.7	961.1
					28	17.4	959.1
					30	7.5	933.6

x = -150mm, y = 50mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
30.00	3.079	0.037	12.2	9.5	2	43.5	701.5
30.50	2.411	0.065	15.5	10.1	4	41.5	790.5
31.00	3.344	0.159	38.5	13.8	6	43.1	911.3

31.50	2.777	0.457	65.2	19.5	8	44.2	953.6
32.00	3.937	0.593	52.4	44.5	10	44.4	964.4
32.50	2.880	0.818	36.1	65.3	12	42.4	967.3
33.00	2.880	0.920	27.5	96.3	14	41.1	968.7
33.50	3.575	0.965	12.8	269.6	16	37.1	968.5
34.00	2.570	0.998	1.2	2138.5	18	35.0	968.7
					20	35.0	968.4
					22	31.8	968.1
					24	28.5	968.0
					26	23.0	967.6
					28	16.6	963.0
					30	7.6	947.4

x = -150mm, y = 75mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
26.50	3.418	0.073	25.1	9.9	2	14.1	650.0
27.00	3.380	0.070	16.2	14.7	4	16.9	693.5
27.50	3.380	0.101	26.6	12.8	6	17.0	835.7
28.00	3.494	0.286	52.3	19.1	8	16.4	917.1
28.50	3.702	0.238	40.6	21.7	10	15.5	956.3
29.00	3.274	0.190	35.8	17.3	12	13.8	964.2
29.50	3.206	0.386	39.6	31.3	14	12.0	967.3
30.00	3.616	0.541	52.1	37.5	16	9.9	967.4
30.50	3.494	0.631	39.0	56.5	18	8.1	967.8
31.00	3.494	0.840	38.1	77.1	20	7.5	967.0
31.50	3.456	0.878	25.8	117.6	22	6.8	967.5
32.00	3.616	0.941	17.5	194.5	24	24.3	966.6
32.50	3.616	0.976	7.2	490.3	26	18.6	945.8
33.00	3.616	0.991	3.8	943.0	28	14.5	942.4
33.50	3.494	0.988	6.4	539.3	30	6.1	807.6
34.00	4.203	0.996	1.9	2203.1			

x = -150mm, y = 100mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
24.00	2.853	0.017	30.4	1.6	2	24.7	718.3
25.00	2.658	0.019	25.0	2.1	4	23.1	752.5
26.00	2.777	0.037	52.3	1.9	6	21.8	888.8
27.00	5.016	0.001	2.5	1.3	8	22.2	921.4
28.00	4.507	0.006	9.2	2.8	10	17.4	944.6
29.00	3.240	0.494	208.8	7.7	12	15.2	943.7
30.00	3.309	0.617	229.5	8.9	14	17.8	952.6
31.00	3.309	0.733	201.8	12.0	16	23.0	946.8
32.00	3.344	0.811	159.6	17.0	18	22.2	937.7

33.00	3.380	0.919	84.6	36.7	20	29.3	932.5
34.00	3.380	0.968	43.4	75.4	22	35.5	920.5
35.00	3.344	0.974	36.6	89.0	24	28.6	912.9
36.00	3.418	0.992	13.5	251.1	26	22.2	873.4
					28	10.3	783.7
					30	6.3	636.1

x = -150mm, y = 115mm		Exp. DT3		Q_w = 26.3L/s	D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
27.00	2.962	0.001	4.0	1.0	2	11.0	558.4
28.00	4.642	0.004	6.4	2.8	4	13.0	551.3
28.50	3.141	0.013	13.4	3.1	6	12.1	568.1
29.00	2.802	0.017	18.3	2.6	8	12.3	598.3
29.50	3.494	0.058	35.1	5.8	10	11.3	652.2
30.00	3.456	0.074	43.8	5.8	12	9.7	678.1
30.50	3.274	0.228	85.5	8.7	14	9.0	705.1
31.00	3.380	0.273	92.9	9.9	16	8.4	710.3
31.50	3.274	0.591	108.9	17.8	18	8.0	703.6
32.00	3.274	0.635	100.6	20.7	20	43.3	698.1
32.50	3.380	0.798	66.0	40.9	22	35.9	674.1
33.00	3.456	0.830	52.9	54.3	24	26.5	640.9
33.50	3.274	0.953	25.0	124.8	26	17.4	574.4
34.00	3.344	0.946	20.7	152.8	28	8.1	517.4
35.00	3.309	0.991	7.8	420.5	30	4.1	484.7
					32	2.4	427.7
					34	1.6	307.5

x = 0mm, y = 0mm		Exp. DT3		Q_w = 26.3L/s	D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
170.50	3.173	0.001	3.3	1.1	144	5.1	383.6
171.50	3.309	0.081	37.1	7.3	146	6.4	756.1
172.00	4.092	0.126	51.1	10.1	148	8.5	885.7
172.50	3.309	0.321	100.9	10.5	150	10.8	947.9
173.00	3.534	0.362	87.4	14.6	152	13.5	962.9
173.50	3.494	0.633	79.8	27.7	154	15.6	964.9
174.00	3.380	0.510	93.7	18.4	156	17.3	964.8
174.50	3.494	0.750	67.7	38.7	158	20.7	964.4
175.00	3.575	0.894	48.9	65.3	160	21.9	964.3
176.00	3.380	0.982	9.3	357.1	162	22.7	962.9
					164	23.0	961.8
					166	21.6	961.5
					168	19.2	960.2
					170	15.7	959.0

					172	8.4	953.3
					174	4.2	774.6

x = 25mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
142.50	3.019	0.993	17.2	174.3	143	4.7	154.4
142.75	2.934	0.972	59.1	48.3	145	3.8	658.5
143.00	3.019	0.885	181.0	14.8	147	3.6	834.4
143.25	3.019	0.731	325.6	6.8	149	1.7	915.1
143.50	2.962	0.467	392.0	3.5	151	-0.3	956.4
143.75	3.019	0.202	287.1	2.1	153	-2.0	964.8
144.00	3.019	0.071	144.5	1.5	155	-3.1	966.9
170.50	3.702	0.015	10.8	5.0	157	-3.9	965.3
171.50	3.418	0.137	47.4	9.9	159	-4.0	966.1
172.00	3.494	0.360	67.3	18.7	161	-3.7	963.9
172.50	3.494	0.407	72.9	19.5	163	-2.9	964.9
173.00	3.456	0.415	78.5	18.3	165	-1.1	962.9
173.50	3.418	0.496	76.8	22.1	167	22.4	960.5
174.00	3.456	0.637	63.8	40.9	169	18.3	956.7
174.50	3.494	0.708	78.9	31.4	171	13.3	958.7
175.00	3.456	0.939	27.2	119.3	173	5.8	917.2
176.00	3.575	0.994	6.1	582.3			

x = 50mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
141.0	3.141	0.995	9.0	347.2	142	1.8	154.6
141.5	2.990	0.964	52.6	54.8	144	2.3	267.9
142.0	3.141	0.871	146.6	18.7	146	4.3	630.5
142.5	3.173	0.597	303.6	6.2	148	7.8	790.9
143.0	3.141	0.262	263.1	3.1	150	11.2	865.4
143.5	3.206	0.073	119.0	2.0	152	14.1	939.7
144.0	3.173	0.014	30.2	1.5	154	16.0	950.2
169.5	3.240	0.069	48.4	4.6	156	16.2	967.4
170.5	3.494	0.210	56.6	12.9	158	17.7	968.2
171.0	3.534	0.456	76.8	21.0	160	18.9	969.0
171.5	3.110	0.775	59.3	40.7	162	18.6	968.2
172.0	3.418	0.795	54.1	50.3	164	18.7	965.5
172.5	3.344	0.853	46.7	61.1	166	17.9	964.1
173.0	3.456	0.865	46.4	64.4	168	15.1	966.4
173.5	3.418	0.977	14.9	224.1	170	14.3	958.5
174.0	3.534	0.973	17.3	198.8	172	8.6	953.3
175.0	2.392	0.998	1.3	1837.3			

x = 100mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
136.0	3.141	0.996	2.7	1158.4	139	7.9	536.9
137.0	3.173	0.985	17.9	174.7	141	8.9	717.0
137.5	3.141	0.959	40.6	74.2	143	11.7	817.8
138.0	3.240	0.895	93.9	30.9	145	13.9	887.9
138.5	3.274	0.775	166.6	15.2	147	15.6	937.1
139.0	3.173	0.598	207.2	9.2	149	17.2	958.9
139.5	3.206	0.426	231.9	5.9	151	18.1	966.5
140.0	3.141	0.224	175.9	4.0	153	19.9	968.7
140.5	3.206	0.102	115.5	2.8	155	20.6	968.1
141.5	3.274	0.013	23.1	1.9	157	21.0	967.4
166.5	3.206	0.083	32.1	8.3	159	22.0	968.4
167.5	3.616	0.106	31.6	12.2	161	21.0	967.0
168.0	3.418	0.258	49.4	17.9	163	19.9	964.6
168.5	3.173	0.442	47.9	29.3	165	15.4	962.9
169.0	3.380	0.527	59.6	29.9	167	11.0	944.2
169.5	3.309	0.897	26.3	112.8	169	5.0	769.8
170.0	3.309	0.769	43.9	58.0			
170.5	3.575	0.903	24.6	131.3			
171.0	3.456	0.931	20.3	158.5			
172.0	3.747	0.994	2.9	1284.6			

x = 200mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
123.0	3.344	0.997	2.6	1282.4	128	3.6	451.5
125.0	3.456	0.964	29.3	113.7	130	6.4	702.7
126.0	3.380	0.922	55.7	55.9	132	9.8	807.4
126.5	3.380	0.865	89.3	32.7	134	11.8	902.1
127.0	3.456	0.800	115.6	23.9	136	14.2	936.0
127.5	3.456	0.692	145.7	16.4	138	16.2	956.9
128.0	3.380	0.609	165.4	12.4	140	16.8	964.8
128.5	3.380	0.486	179.6	9.2	142	18.3	965.0
129.0	3.380	0.388	170.8	7.7	144	18.6	967.8
129.5	3.344	0.269	155.0	5.8	146	21.3	967.7
130.0	3.344	0.231	141.4	5.5	148	20.1	966.3
131.0	3.274	0.087	75.3	3.8	150	18.5	965.4
133.0	3.110	0.015	15.4	3.0	152	17.6	963.5
153.5	2.934	0.011	8.4	3.7	154	12.3	944.2
155.0	3.019	0.119	37.2	9.6	156	6.9	819.9
156.0	3.141	0.288	53.8	16.8	158	3.2	655.3
156.5	3.173	0.226	47.4	15.1			
157.0	3.141	0.411	65.1	19.8			

157.5	3.240	0.487	51.6	30.6
158.0	3.380	0.517	57.6	30.3
158.5	3.380	0.783	40.0	66.1
159.0	3.456	0.700	49.9	48.5
159.5	3.380	0.776	44.5	58.9
160.0	3.418	0.873	31.9	93.6
161.0	3.380	0.959	12.5	259.4
162.5	3.702	0.997	1.8	2051.3

$x = 300$mm, $y = 0$mm			Exp. DT3	$Q_w = 26.3$L/s		$D = 46$mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
104.0	3.456	0.994	5.2	660.3	112	2.2	661.6
106.0	3.274	0.980	12.7	252.7	114	5.0	796.8
108.0	3.534	0.871	71.1	43.3	116	7.4	890.1
109.0	3.380	0.802	91.3	29.7	118	11.0	930.7
110.0	3.494	0.604	139.4	15.1	120	12.8	950.3
111.0	3.494	0.544	148.0	12.9	122	16.8	961.3
112.0	3.380	0.435	137.7	10.7	124	18.8	965.7
113.0	3.380	0.302	134.3	7.6	126	19.7	965.9
115.0	3.344	0.189	101.1	6.3	128	20.8	964.0
116.0	3.309	0.076	49.6	5.1	130	20.7	964.5
118.0	3.206	0.019	15.3	4.0	132	19.3	962.9
120.0	3.110	0.005	4.6	3.6	134	16.3	961.1
135.0	2.962	0.017	5.4	9.3	136	9.9	949.5
137.0	3.240	0.056	13.0	14.0	138	6.1	912.7
138.0	3.141	0.221	35.2	19.8	140	1.0	767.2
139.0	3.079	0.319	41.4	23.7			
140.0	3.456	0.787	31.3	86.9			
141.0	3.206	0.806	28.4	91.0			
142.0	3.534	0.877	20.3	152.6			
143.0	3.418	0.965	7.9	417.2			
145.0	3.888	0.990	2.1	1832.3			

$x = 400$mm, $y = 0$mm			Exp. DT3	$Q_w = 26.3$L/s		$D = 46$mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
80.0	3.380	0.992	4.8	698.8	90	6.2	707.0
83.0	3.456	0.954	23.9	137.9	92	8.0	812.2
85.0	3.494	0.819	64.2	44.6	94	14.4	902.5
87.0	3.456	0.771	82.7	32.2	96	16.1	929.4
88.0	3.494	0.644	108.0	20.9	98	-5.3	941.4
89.0	3.456	0.557	119.9	16.1	100	9.4	956.9
90.0	3.494	0.432	127.1	11.9	102	-7.8	962.1
91.0	3.456	0.328	115.8	9.8	104	-6.7	963.6

92.0	3.456	0.179	82.9	7.4	106	-5.8	963.8
93.0	3.456	0.170	83.5	7.0	108	3.7	959.0
95.0	3.380	0.056	34.2	5.5	110	10.2	918.0
97.0	3.380	0.027	19.5	4.7	112	10.0	846.9
100.0	3.240	0.007	5.5	4.3	114	7.0	680.1
112.0	2.304	0.027	7.2	8.8	116	2.9	548.2
114.0	2.853	0.141	23.0	17.5			
115.0	3.274	0.244	38.3	20.9			
116.0	3.206	0.473	38.9	39.0			
117.0	3.456	0.452	41.3	37.8			
118.0	3.418	0.665	38.7	58.7			
119.0	3.575	0.804	30.0	95.8			
120.0	3.274	0.899	15.3	192.4			
121.0	3.380	0.947	8.3	385.8			
123.0	3.616	0.994	2.8	1283.3			

x = 400mm, y = 25mm		Exp. DT3		Q_w = 26.3L/s	D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
73.0	3.534	0.998	1.3	2714.2	86	1.8	531.8
76.0	3.702	0.966	11.7	305.8	88	2.7	689.7
78.0	3.840	0.972	16.7	223.4	90	5.7	826.9
80.0	3.793	0.910	45.3	76.2	92	9.2	866.7
82.0	3.747	0.779	87.7	33.3	94	15.0	918.6
84.0	3.793	0.595	120.4	18.7	96	2.5	943.4
86.0	3.747	0.370	121.8	11.4	98	-5.4	956.0
88.0	3.659	0.194	102.2	7.0	100	7.5	963.6
90.0	3.616	0.078	49.1	5.7	102	-6.0	964.8
92.0	3.380	0.026	20.0	4.5	104	19.6	965.3
95.0	3.494	0.004	3.5	3.9	106	18.1	955.9
105.0	3.049	0.009	2.3	11.9	108	15.0	956.9
108.0	3.173	0.025	5.2	15.4	110	8.6	944.9
110.0	3.274	0.104	16.3	20.9	112	4.0	888.1
112.0	3.380	0.257	25.9	33.5	114	2.2	766.7
114.0	3.456	0.437	30.8	49.1	116	0.1	643.7
116.0	3.494	0.593	33.7	61.5			
118.0	3.494	0.893	18.3	170.6			
120.0	4.203	0.996	1.3	3219.3			
123.0	4.092	0.999	0.5	8177.6			

x = 400mm, y = 50mm		Exp. DT3		Q_w = 26.3L/s	D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
65.0	3.380	0.998	0.9	3748.4	84	1.3	532.7
70.0	3.206	0.988	4.0	791.7	86	2.9	653.6

75.0	3.494	0.882	25.7	119.9	88	5.4	710.3
78.0	3.456	0.851	35.8	82.2	90	9.1	763.6
80.0	3.747	0.230	60.1	14.3	92	12.7	800.0
82.0	3.616	0.598	65.4	33.1	94	-4.1	840.6
84.0	3.616	0.617	67.2	33.2	96	15.5	887.4
86.0	3.659	0.440	85.8	18.8	98	18.2	904.9
90.0	3.575	0.138	45.1	11.0	100	19.3	911.0
92.0	3.534	0.111	32.8	11.9	102	18.9	944.8
95.0	3.616	0.079	21.0	13.5	104	17.5	912.8
100.0	3.344	0.028	11.3	8.2	106	14.2	944.5
105.0	3.456	0.045	16.8	9.3	108	11.1	957.7
110.0	3.534	0.029	8.1	12.5	110	6.8	938.1
112.0	3.344	0.075	16.1	15.6	112	5.2	906.9
114.0	3.274	0.253	31.4	26.4	114	1.6	760.6
116.0	3.575	0.532	41.9	45.4	116	0.0	430.1
117.0	3.456	0.463	53.0	30.2			
118.0	3.456	0.742	32.4	79.2			
119.0	3.418	0.773	35.8	73.8			
120.0	3.456	0.925	19.6	163.1			
122.0	3.616	0.935	15.3	221.1			
124.0	3.575	0.969	8.2	422.6			

x = 400mm, y = 75mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
62.0	3.380	0.999	0.5	6756.0	82	3.7	455.1
66.0	3.575	0.996	2.4	1483.0	84	4.1	497.6
69.0	3.575	0.989	6.3	561.2	86	4.9	550.0
72.0	3.793	0.960	18.9	192.6	88	6.0	691.5
75.0	3.702	0.846	47.0	66.6	90	6.7	653.0
78.0	3.702	0.703	79.1	32.9	92	8.9	663.5
81.0	3.616	0.547	90.5	21.9	94	9.2	721.7
84.0	3.534	0.401	89.9	15.8	96	13.5	780.3
87.0	3.456	0.367	80.0	15.8	98	6.9	740.0
90.0	3.456	0.279	83.6	11.6	100	13.3	748.3
93.0	3.534	0.318	101.7	11.1	102	11.4	795.9
96.0	3.456	0.358	110.2	11.2	104	11.5	820.6
99.0	3.456	0.263	82.2	11.1	106	12.2	860.5
102.0	3.494	0.266	61.5	15.1	108	9.1	840.1
105.0	3.494	0.290	68.7	14.7	110	4.7	793.7
108.0	3.418	0.120	39.1	10.5	112	2.6	765.6
111.0	3.456	0.282	44.3	22.0			
114.0	3.494	0.396	51.4	26.9			
117.0	3.575	0.632	50.6	44.7			

120.0	3.659	0.823	34.3	87.8
123.0	3.747	0.940	15.1	233.2
126.0	3.659	0.967	8.1	436.7

x = 400mm, y = 100mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
60.0	3.534	0.998	1.0	3527.8	80	5.1	554.1
65.0	3.840	0.988	6.4	592.8	82	4.9	714.1
70.0	3.747	0.952	21.7	164.3	84	5.8	786.4
72.0	3.702	0.903	37.9	88.2	86	6.1	815.0
74.0	3.702	0.860	55.6	57.3	88	6.1	852.3
76.0	3.659	0.782	66.8	42.8	90	5.9	845.8
78.0	3.659	0.639	93.3	25.1	92	5.5	861.0
80.0	3.702	0.605	99.1	22.6	94	5.1	819.0
82.0	3.616	0.308	98.1	11.3	96	4.5	777.8
84.0	3.575	0.224	88.8	9.0	98	4.9	706.2
86.0	3.575	0.163	76.2	7.7	100	5.2	659.4
90.0	3.494	0.113	48.7	8.1	102	7.7	556.6
94.0	3.380	0.126	51.0	8.3			
96.0	3.575	0.259	65.2	14.2			
98.0	3.575	0.318	78.6	14.5			
100.0	3.616	0.389	71.4	19.7			
102.0	3.534	0.463	74.6	21.9			
104.0	3.575	0.509	78.6	23.2			
106.0	3.747	0.661	78.1	31.7			
108.0	3.659	0.767	54.3	51.7			
110.0	3.616	0.791	47.8	59.8			
112.0	3.747	0.877	35.1	93.6			
115.0	3.793	0.907	26.9	127.9			
120.0	3.937	0.977	7.7	499.7			
125.0	3.793	0.974	5.9	626.0			
130.0	3.747	0.997	1.3	2872.9			

x = 400mm, y = 120mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm			x = 500mm, y = 0mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
40.0	3.380	0.884	23.5	127.2	48.0	3.702	0.762	52.9	53.4
45.0	3.575	0.830	49.3	60.2	50.0	3.575	0.817	56.1	52.1
50.0	3.534	0.788	57.2	48.7	52.0	3.659	0.880	53.4	60.3
55.0	3.659	0.681	84.1	29.6	54.0	3.534	0.791	82.7	33.8
60.0	3.616	0.673	81.8	29.8	56.0	3.494	0.748	93.0	28.1
65.0	3.616	0.630	91.1	25.0	58.0	3.494	0.556	107.4	18.1
70.0	3.659	0.629	96.2	23.9	60.0	3.494	0.330	101.2	11.4
75.0	3.616	0.750	79.1	34.3	62.0	3.380	0.199	74.1	9.1

80.0	3.702	0.835	60.8	50.8
85.0	3.793	0.876	47.0	70.7
90.0	3.747	0.957	20.4	175.8
95.0	3.987	0.996	2.2	1805.3
100.0	3.888	0.996	1.7	2278.5
105.0	3.793	0.996	1.7	2222.1

64.0	3.380	0.181	67.1	9.1
66.0	3.309	0.069	36.4	6.2
68.0	3.274	0.028	15.8	5.8
70.0	3.344	0.011	5.5	6.5
78.0	2.488	0.024	4.8	12.4
80.0	3.840	0.029	7.1	15.6
82.0	3.380	0.118	18.3	21.8
84.0	3.079	0.342	32.3	32.6
86.0	3.240	0.668	33.7	64.2
88.0	3.494	0.791	20.1	137.4
90.0	3.380	0.936	10.9	290.1
92.0	3.840	0.998	0.6	6386.4
94.0	5.016	1.000	0.2	25073.0

x = 600mm, y = 0mm			Exp. DT3		Q_w = 26.3L/s		D = 46mm		x = 600mm, y = 25mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.206	0.218	205.8	2.3	6.0	3.110	0.032	103.3	1.0
8.0	3.344	0.228	216.9	3.5	10.0	3.206	0.042	111.8	1.2
10.0	3.702	0.298	257.3	4.3	14.0	3.141	0.057	136.7	1.3
12.0	3.747	0.279	248.4	4.2	18.0	3.240	0.082	144.7	1.8
14.0	3.344	0.338	281.1	4.0	21.0	3.206	0.098	140.9	2.2
16.0	3.309	0.311	279.6	3.7	24.0	3.309	0.194	150.4	4.3
18.0	3.309	0.273	245.8	3.7	26.0	3.380	0.284	161.0	6.0
20.0	3.616	0.236	215.8	4.0	28.0	3.494	0.375	146.7	8.9
22.0	3.494	0.178	179.9	3.5	30.0	3.380	0.382	138.3	9.3
24.0	3.575	0.110	99.8	3.9	32.0	3.534	0.467	137.5	12.0
26.0	3.747	0.071	63.4	4.2	34.0	3.534	0.557	128.9	15.3
28.0	3.793	0.036	35.7	3.8	36.0	3.534	0.644	129.7	17.6
30.0	3.534	0.028	24.2	4.2	38.0	3.616	0.731	113.0	23.4
32.0	3.747	0.014	11.2	4.6	40.0	3.575	0.727	107.6	24.2
34.0	3.747	0.011	8.1	5.1	42.0	3.616	0.786	96.5	29.4
36.0	3.494	0.007	3.5	6.6	44.0	3.659	0.846	71.8	43.1
38.0	3.659	0.014	5.0	9.9	46.0	3.659	0.871	65.9	48.4
40.0	3.534	0.014	5.7	8.6	49.0	3.702	0.897	53.9	61.6
42.0	5.016	0.115	16.1	35.7	52.0	3.616	0.941	39.8	85.5
44.0	5.016	0.158	17.2	46.0	56.0	3.702	0.964	27.1	131.7
46.0	5.016	0.450	29.2	77.3	60.0	3.575	0.977	20.0	174.6
48.0	2.636	0.662	28.5	61.2	65.0	3.494	0.991	8.2	422.1
50.0	2.508	0.880	18.8	117.4	70.0	3.793	0.991	9.8	383.4
52.0	5.016	0.984	3.5	1411.0					

x = 600mm, y = 50mm		Exp. DT3		Q_w = 26.3L/s		D = 46mm		x = 600mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.206	0.244	207.5	3.8	6.0	2.907	0.174	160.6	3.1
8.0	2.728	0.240	207.2	3.2	9.0	2.728	0.216	200.7	2.9
10.0	2.287	0.277	233.5	2.7	12.0	2.704	0.226	207.7	2.9
12.0	2.488	0.252	218.3	2.9	15.0	3.049	0.229	220.4	3.2
14.0	2.752	0.227	206.7	3.0	18.0	3.049	0.221	194.2	3.5
16.0	3.240	0.203	186.3	3.5	20.0	3.380	0.211	189.1	3.8
18.0	3.309	0.262	213.1	4.1	22.0	3.173	0.200	182.3	3.5
20.0	3.380	0.173	151.5	3.9	24.0	3.206	0.211	164.6	4.1
22.0	3.888	0.165	136.2	4.7	26.0	3.494	0.205	142.5	5.0
24.0	3.380	0.132	109.4	4.1	28.0	3.534	0.198	114.2	6.1
26.0	3.418	0.138	104.4	4.5	30.0	3.534	0.178	101.1	6.2
28.0	3.534	0.082	63.3	4.6	32.0	3.534	0.188	100.3	6.6
30.0	3.747	0.039	31.5	4.7	34.0	3.575	0.272	103.8	9.4
32.0	3.793	0.033	24.6	5.1	36.0	3.659	0.216	84.7	9.3
34.0	3.793	0.032	20.9	5.8	38.0	3.793	0.235	91.6	9.7
36.0	3.747	0.059	32.3	6.9	40.0	3.840	0.168	60.0	10.7
38.0	3.793	0.049	24.4	7.6	42.0	3.840	0.253	65.5	14.8
40.0	3.702	0.042	13.5	11.6	44.0	3.937	0.255	52.7	19.1
42.0	3.937	0.085	24.1	13.9	46.0	3.747	0.359	54.1	24.9
44.0	3.888	0.106	21.5	19.1	48.0	4.039	0.408	57.8	28.5
46.0	3.937	0.473	37.3	49.9	50.0	3.888	0.617	52.0	46.1
48.0	5.016	0.745	26.8	139.4	52.0	4.147	0.728	43.8	68.9
50.0	4.260	0.730	38.4	81.0	54.0	3.793	0.872	26.4	125.2
52.0	4.260	0.914	17.9	217.5	56.0	3.793	0.913	22.3	155.3
54.0	5.016	0.983	4.4	1120.1	58.0	3.702	0.960	10.9	326.1
56.0	5.016	0.994	2.1	2375.2	60.0	5.016	0.994	2.4	2076.5
					62.0	4.712	0.990	3.8	1228.0

x = 600mm, y = 100mm		Exp. DT3		Q_w = 26.3L/s		D = 46mm		x = 600mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.392	0.155	207.8	1.8	6.0	2.549	0.081	148.2	1.4
8.0	2.338	0.178	213.8	1.9	9.0	2.681	0.118	206.1	1.5
10.0	2.528	0.204	235.3	2.2	12.0	2.934	0.167	248.8	2.0
12.0	3.079	0.203	235.9	2.6	15.0	2.990	0.266	313.4	2.5
14.0	3.240	0.197	214.6	3.0	18.0	3.344	0.275	299.2	3.1
16.0	3.418	0.208	213.0	3.3	21.0	3.206	0.452	339.9	4.3
18.0	3.344	0.189	183.6	3.4	24.0	3.141	0.575	329.9	5.5
20.0	3.575	0.189	157.4	4.3	27.0	3.206	0.665	280.2	7.6
22.0	3.702	0.239	140.7	6.3	30.0	2.934	0.686	252.0	8.0
24.0	3.616	0.268	127.9	7.6	33.0	2.752	0.701	220.8	8.7
26.0	3.793	0.373	115.7	12.2	36.0	2.681	0.692	172.4	10.8
28.0	3.840	0.433	101.0	16.5	39.0	2.827	0.773	119.0	18.4

30.0	3.937	0.445	110.9	15.8	42.0	2.392	0.784	109.1	17.2
32.0	4.039	0.710	73.8	38.8	45.0	2.356	0.826	78.0	25.0
34.0	3.987	0.655	86.2	30.3	48.0	1.968	0.838	62.5	26.4
36.0	4.092	0.811	51.6	64.3	51.0	2.287	0.883	39.8	50.8
38.0	4.203	0.846	45.4	78.3	54.0	1.767	0.932	24.4	67.5
40.0	4.147	0.864	40.8	87.8	57.0	1.474	0.960	13.8	102.5
42.0	4.260	0.923	23.6	166.6	60.0	2.528	0.971	11.7	209.8
44.0	4.147	0.942	16.5	236.8	63.0	1.777	0.981	6.9	252.7
46.0	4.203	0.936	21.5	182.9	66.0	2.060	0.989	4.6	443.0
48.0	4.319	0.971	8.6	487.5					
50.0	4.260	0.980	6.0	696.1					
52.0	4.147	0.948	12.7	309.4					
54.0	3.937	0.988	3.7	1051.1					
56.0	4.642	0.962	9.0	496.0					

x = 700mm, y = 0mm			Exp. DT3		Q_w = 26.3L/s		D = 46mm		x = 700mm, y = 25mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.990	0.048	146.5	1.0	6.0	2.962	0.056	154.8	1.1
9.0	3.141	0.054	155.3	1.1	9.0	3.110	0.054	151.0	1.1
12.0	3.206	0.063	166.1	1.2	12.0	3.206	0.067	158.6	1.3
15.0	3.240	0.066	148.7	1.4	15.0	3.344	0.059	123.3	1.6
18.0	3.173	0.056	114.2	1.6	18.0	3.534	0.053	107.0	1.8
20.0	3.309	0.057	115.7	1.6	20.0	3.494	0.046	85.0	1.9
22.0	3.456	0.045	84.7	1.8	22.0	3.534	0.047	79.6	2.1
24.0	3.494	0.052	89.0	2.0	24.0	3.702	0.034	53.6	2.4
26.0	3.494	0.039	69.0	2.0	26.0	3.702	0.047	55.1	3.2
27.0	3.616	0.060	76.7	2.8	27.0	3.575	0.076	60.5	4.5
28.0	3.534	0.065	64.2	3.6	28.0	3.380	0.122	53.0	7.8
29.0	3.616	0.126	79.7	5.7	29.0	3.380	0.257	60.6	14.3
30.0	3.575	0.214	79.0	9.7	30.0	3.494	0.340	71.4	16.6
31.0	3.494	0.331	89.8	12.9	31.0	3.380	0.542	59.5	30.8
32.0	3.494	0.509	84.7	21.0	32.0	3.418	0.618	68.6	30.8
33.0	3.575	0.577	84.0	24.5	33.0	3.418	0.687	57.4	40.9
34.0	3.659	0.624	75.1	30.4	34.0	3.380	0.776	48.4	54.2
35.0	3.702	0.731	67.2	40.3	35.0	3.702	0.851	36.5	86.3
36.0	3.793	0.812	52.9	58.2	36.0	3.702	0.863	41.1	77.7
37.0	3.747	0.856	43.9	73.1	37.0	3.702	0.920	29.7	114.7
38.0	3.793	0.883	38.0	88.2	38.0	3.888	0.918	36.3	98.3
40.0	3.702	0.932	24.9	138.6	40.0	3.747	0.960	22.0	163.5
42.0	3.702	0.960	22.2	160.2	42.0	3.659	0.967	18.1	195.5
45.0	3.575	0.983	9.7	362.4	45.0	3.616	0.990	7.1	504.1
48.0	3.534	0.990	6.6	530.2	48.0	3.888	0.991	5.5	700.7

x = 700mm, y = 50mm									x = 700mm, y = 75mm
Exp. DT3	Q_w = 26.3L/s	D = 46mm							
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.962	0.054	136.0	1.2	6.0	3.079	0.073	169.0	1.3
9.0	3.079	0.060	137.6	1.3	10.0	3.110	0.075	163.1	1.4
12.0	3.141	0.069	135.0	1.6	14.0	3.240	0.084	157.8	1.7
15.0	3.344	0.069	127.4	1.8	16.0	3.206	0.080	148.2	1.7
18.0	3.380	0.063	112.2	1.9	18.0	3.344	0.116	193.0	2.0
20.0	3.494	0.058	93.4	2.2	20.0	3.344	0.110	173.3	2.1
22.0	3.575	0.078	114.5	2.4	22.0	3.575	0.104	144.4	2.6
24.0	3.616	0.052	69.2	2.7	24.0	3.747	0.133	131.4	3.8
26.0	3.747	0.046	41.5	4.2	26.0	3.793	0.341	156.1	8.3
27.0	3.702	0.114	68.4	6.2	27.0	3.793	0.394	204.6	7.3
28.0	3.616	0.236	118.4	7.2	28.0	3.793	0.616	139.4	16.8
29.0	3.616	0.403	120.9	12.1	29.0	3.793	0.602	168.9	13.5
30.0	3.616	0.510	104.6	17.6	30.0	3.840	0.727	129.4	21.6
31.0	3.659	0.643	100.5	23.4	31.0	3.840	0.682	199.2	13.1
32.0	3.702	0.706	81.8	32.0	32.0	3.702	0.752	148.2	18.8
33.0	3.659	0.772	84.2	33.5	33.0	3.793	0.869	83.4	39.5
34.0	3.793	0.803	84.3	36.1	34.0	3.937	0.910	64.1	55.9
35.0	3.747	0.911	34.5	99.0	35.0	3.888	0.898	83.7	41.7
36.0	3.840	0.926	40.0	88.9	36.0	3.747	0.921	66.5	51.9
37.0	3.840	0.953	27.6	132.6	38.0	3.793	0.946	51.0	70.4
38.0	3.747	0.915	53.4	64.2	40.0	3.888	0.959	38.3	97.3
40.0	3.840	0.978	18.0	208.6	43.0	4.092	0.979	26.7	150.1
42.0	3.888	0.984	13.2	289.8	46.0	3.937	0.983	17.7	218.7
45.0	3.840	0.997	2.7	1418.3	50.0	3.793	0.992	12.3	305.8
48.0	3.840	0.997	3.5	1093.6					

x = 700mm, y = 100mm									x = 700mm, y = 120mm
Exp. DT3	Q_w = 26.3L/s	D = 46mm							
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.019	0.068	153.6	1.3	6.0	2.802	0.029	81.5	1.0
8.0	3.079	0.075	156.9	1.5	11.0	2.934	0.051	130.2	1.2
10.0	3.079	0.077	164.9	1.4	15.0	3.019	0.058	138.1	1.3
12.0	3.141	0.090	177.1	1.6	18.0	2.777	0.085	176.2	1.3
14.0	2.962	0.090	163.7	1.6	21.0	2.752	0.115	219.8	1.4
16.0	3.240	0.102	168.9	2.0	24.0	3.141	0.178	264.3	2.1
18.0	3.456	0.165	194.4	2.9	27.0	3.173	0.220	299.9	2.3
20.0	3.702	0.310	197.3	5.8	30.0	3.494	0.285	327.9	3.0
22.0	3.702	0.366	209.4	6.5	33.0	3.534	0.372	354.2	3.7
24.0	3.702	0.552	217.0	9.4	36.0	3.494	0.394	361.1	3.8
26.0	3.747	0.651	207.0	11.8	39.0	3.793	0.480	346.2	5.3
28.0	3.747	0.777	161.2	18.1	42.0	3.575	0.429	348.7	4.4
30.0	3.793	0.782	181.2	16.4	45.0	3.702	0.463	317.2	5.4
35.0	3.575	0.919	82.1	40.0	50.0	3.888	0.524	290.3	7.0

40.0	3.173	0.934	56.7	52.3
45.0	2.430	0.945	42.0	54.7
50.0	2.145	0.945	38.3	52.9
55.0	2.046	0.923	51.9	36.4
60.0	2.033	0.938	37.2	51.3
65.0	1.944	0.955	26.8	69.3
70.0	1.908	0.955	26.0	70.1
75.0	1.908	0.972	14.0	132.4
80.0	1.777	0.967	16.1	106.8
90.0	2.190	0.992	2.8	776.2
100.0	1.346	0.996	1.4	957.6

55.0	3.840	0.562	231.4	9.3
60.0	3.793	0.562	187.1	11.4
63.0	4.147	0.617	160.8	15.9
66.0	3.987	0.716	116.4	24.5
69.0	3.141	0.748	102.6	22.9
72.0	2.392	0.816	67.9	28.7
75.0	4.092	0.872	53.0	67.3
78.0	2.592	0.915	34.3	69.1
81.0	1.808	0.961	17.7	98.2
85.0	1.290	0.969	14.0	89.3
90.0	1.275	0.990	5.0	252.3
100.0	2.681	0.998	1.1	2432.9

x = 800mm, y = 0mm Exp. DT3 Q_w = 26.3L/s D = 46mm x = 800mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.049	0.027	84.6	1.0
10.0	3.206	0.034	99.4	1.1
14.0	3.309	0.039	96.0	1.4
16.0	3.274	0.058	120.9	1.6
18.0	3.309	0.076	130.5	1.9
20.0	3.274	0.081	125.9	2.1
22.0	3.344	0.091	109.6	2.8
24.0	3.344	0.142	127.8	3.7
26.0	3.456	0.259	143.3	6.2
28.0	3.534	0.437	162.4	9.5
30.0	3.616	0.624	118.4	19.1
32.0	3.534	0.650	106.2	21.6
34.0	3.702	0.821	82.6	36.8
36.0	3.616	0.813	101.8	28.9
38.0	3.659	0.863	74.6	42.3
40.0	3.616	0.872	75.3	41.9
43.0	3.616	0.929	47.5	70.8
46.0	3.659	0.926	55.3	61.3
50.0	3.575	0.965	26.0	132.7
55.0	3.616	0.985	13.8	258.1
60.0	3.456	0.993	6.9	497.2
70.0	3.793	0.997	3.2	1181.3

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.110	0.032	103.3	1.0
10.0	3.206	0.042	111.8	1.2
14.0	3.141	0.057	136.7	1.3
18.0	3.240	0.082	144.7	1.8
21.0	3.206	0.098	140.9	2.2
24.0	3.309	0.194	150.4	4.3
26.0	3.380	0.284	161.0	6.0
28.0	3.494	0.375	146.7	8.9
30.0	3.380	0.382	138.3	9.3
32.0	3.534	0.467	137.5	12.0
34.0	3.534	0.557	128.9	15.3
36.0	3.534	0.644	129.7	17.6
38.0	3.616	0.731	113.0	23.4
40.0	3.575	0.727	107.6	24.2
42.0	3.616	0.786	96.5	29.4
44.0	3.659	0.846	71.8	43.1
46.0	3.659	0.871	65.9	48.4
49.0	3.702	0.897	53.9	61.6
52.0	3.616	0.941	39.8	85.5
56.0	3.702	0.964	27.1	131.7
60.0	3.575	0.977	20.0	174.6
65.0	3.494	0.991	8.2	422.1
70.0	3.793	0.991	9.8	383.4

x = 800mm, y = 50mm Exp. DT3 Q_w = 26.3L/s D = 46mm x = 800mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.019	0.035	91.7	1.2
10.0	3.079	0.050	112.6	1.4

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.907	0.051	118.6	1.2
8.0	3.079	0.066	138.4	1.5

12.0	3.206	0.058	117.9	1.6
14.0	3.206	0.059	117.5	1.6
16.0	3.274	0.092	136.0	2.2
18.0	3.309	0.122	139.7	2.9
20.0	3.344	0.242	165.2	4.9
22.0	3.456	0.268	144.8	6.4
24.0	3.494	0.390	145.1	9.4
26.0	3.534	0.535	151.2	12.5
28.0	3.575	0.595	157.9	13.5
30.0	3.575	0.679	120.3	20.2
32.0	3.616	0.747	117.0	23.1
34.0	3.702	0.766	100.2	28.3
36.0	3.659	0.818	101.4	29.5
38.0	3.534	0.860	106.5	28.5
40.0	3.616	0.927	56.0	59.8
42.0	3.659	0.925	53.3	63.5
45.0	3.616	0.921	59.7	55.8
48.0	3.534	0.952	42.5	79.2
52.0	3.616	0.970	25.6	137.0
60.0	3.456	0.989	11.9	287.2
70.0	3.079	0.997	3.8	807.8

10.0	3.049	0.087	145.0	1.8
12.0	3.173	0.160	193.6	2.6
14.0	3.173	0.188	207.7	2.9
16.0	3.309	0.254	203.6	4.1
18.0	3.456	0.337	155.9	7.5
20.0	3.534	0.473	199.7	8.4
22.0	3.575	0.566	189.8	10.7
24.0	3.494	0.641	190.9	11.7
26.0	3.534	0.698	177.7	13.9
28.0	3.575	0.751	158.7	16.9
30.0	3.616	0.797	146.2	19.7
32.0	3.534	0.863	99.2	30.7
34.0	3.616	0.908	72.7	45.1
36.0	3.494	0.894	85.5	36.5
39.0	3.456	0.908	82.8	37.9
42.0	3.456	0.946	52.8	61.9
46.0	3.418	0.961	38.2	86.0
50.0	3.418	0.977	23.1	144.6
55.0	3.309	0.979	23.6	137.3
60.0	3.206	0.975	27.2	114.9
70.0	2.321	0.988	7.3	314.1
80.0	2.060	0.993	5.0	409.0
90.0	1.944	0.994	3.5	551.9

x = 800mm, y = 100mm | Exp. DT3 | Q_w = 26.3L/s | D = 46mm | x = 800mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.934	0.070	134.0	1.5
10.0	3.173	0.159	190.1	2.7
14.0	3.418	0.289	206.1	4.8
18.0	3.575	0.518	235.2	7.9
22.0	3.534	0.722	164.1	15.5
26.0	3.494	0.735	174.9	14.7
30.0	3.534	0.802	159.2	17.8
34.0	3.534	0.860	115.5	26.3
38.0	3.494	0.879	106.8	28.8
42.0	3.418	0.897	98.1	31.3
48.0	3.110	0.929	60.2	48.0
54.0	2.488	0.915	70.6	32.2
60.0	2.488	0.922	65.2	35.2
64.0	2.468	0.930	58.4	39.3
68.0	2.321	0.915	65.5	32.4
72.0	2.304	0.904	71.3	29.2
76.0	2.221	0.912	59.3	34.2
80.0	2.160	0.911	63.0	31.2

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.549	0.026	69.2	0.9
10.0	2.907	0.045	112.7	1.2
14.0	2.880	0.068	134.3	1.5
18.0	2.880	0.101	167.6	1.7
21.0	2.990	0.121	189.2	1.9
24.0	3.019	0.141	195.5	2.2
27.0	3.240	0.179	222.7	2.6
30.0	3.344	0.277	249.9	3.7
33.0	3.206	0.220	230.4	3.1
36.0	3.456	0.328	277.9	4.1
39.0	3.456	0.379	293.4	4.5
42.0	3.344	0.403	301.1	4.5
45.0	3.309	0.429	291.8	4.9
50.0	3.344	0.459	310.6	4.9
55.0	3.494	0.503	287.5	6.1
60.0	3.274	0.585	258.0	7.4
65.0	3.240	0.603	256.2	7.6
70.0	3.456	0.655	211.6	10.7

84.0	2.175	0.926	44.7	45.0
88.0	2.060	0.915	56.1	33.6
94.0	2.145	0.940	36.1	55.8
100.0	2.130	0.982	9.9	211.2
110.0	1.920	0.977	12.2	153.8
120.0	1.777	0.995	2.3	769.1

75.0	3.141	0.624	203.8	9.6
80.0	2.907	0.641	191.3	9.7
85.0	2.777	0.698	153.8	12.6
90.0	2.528	0.783	95.8	20.7
93.0	2.853	0.787	97.8	23.0
96.0	2.827	0.822	86.4	26.9
99.0	2.962	0.899	52.3	50.9
102.0	2.116	0.947	27.9	71.8
105.0	2.006	0.956	26.3	72.9
110.0	2.681	0.972	16.3	160.0
115.0	1.757	0.995	4.0	437.3
125.0	1.376	0.997	2.4	571.8

x = 1000mm, y = 0mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm		x = 1000mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.019	0.015	46.2	1.0	6.0	3.049	0.022	63.9	1.0
9.0	2.880	0.023	66.0	1.0	9.0	3.079	0.030	78.9	1.2
12.0	3.019	0.040	88.2	1.4	12.0	3.110	0.044	97.9	1.4
15.0	3.110	0.074	116.9	2.0	15.0	3.110	0.070	109.5	2.0
18.0	3.141	0.103	117.2	2.8	18.0	3.173	0.110	137.4	2.5
20.0	3.380	0.139	122.8	3.8	20.0	3.309	0.149	156.0	3.2
22.0	3.418	0.199	137.8	4.9	22.0	3.456	0.191	146.5	4.5
24.0	3.575	0.294	141.4	7.4	24.0	3.456	0.229	151.7	5.2
26.0	3.616	0.366	163.6	8.1	26.0	3.456	0.315	167.9	6.5
28.0	3.616	0.478	161.8	10.7	28.0	3.575	0.428	171.9	8.9
30.0	3.616	0.545	143.8	13.7	30.0	3.534	0.439	158.3	9.8
32.0	3.659	0.630	145.4	15.8	32.0	3.616	0.556	148.3	13.6
34.0	3.659	0.705	132.8	19.4	34.0	3.616	0.622	146.5	15.4
36.0	3.702	0.750	115.4	24.1	36.0	3.659	0.643	130.9	18.0
39.0	3.702	0.837	91.1	34.0	38.0	3.659	0.724	119.6	22.2
42.0	3.659	0.884	76.8	42.1	41.0	3.659	0.771	107.4	26.3
45.0	3.659	0.893	67.1	48.7	44.0	3.659	0.814	86.8	34.3
50.0	3.702	0.929	51.7	66.5	47.0	3.659	0.861	80.5	39.1
55.0	3.616	0.953	42.5	81.1	50.0	3.659	0.893	71.2	45.9
60.0	3.575	0.966	32.2	107.3	55.0	3.702	0.920	58.8	57.9
65.0	3.494	0.974	23.7	143.6	60.0	3.659	0.947	43.9	78.9
70.0	3.494	0.981	19.1	179.5	65.0	3.659	0.964	29.3	120.4
75.0	3.494	0.986	14.3	241.1	70.0	3.575	0.972	28.4	122.3
80.0	3.494	0.991	11.0	314.7	80.0	3.534	0.989	11.7	298.6
90.0	3.380	0.995	6.8	494.5	90.0	3.456	0.993	8.4	408.3
100.0	3.110	0.997	3.7	837.9	100.0	3.240	0.998	3.5	923.4

x = 1000mm, y = 50mm Exp. DT3 Q_w = 26.3L/s D = 46mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	3.173	0.109	121.6	2.8
9.0	3.418	0.185	152.3	4.2
12.0	3.380	0.273	171.6	5.4
14.0	3.494	0.451	178.6	8.8
16.0	3.575	0.367	173.0	7.6
18.0	3.456	0.315	171.9	6.3
20.0	3.494	0.304	163.4	6.5
22.0	3.575	0.438	170.1	9.2
24.0	3.616	0.610	152.1	14.5
26.0	3.616	0.650	154.3	15.2
28.0	3.616	0.728	144.5	18.2
30.0	3.616	0.747	135.7	19.9
32.0	3.616	0.803	124.0	23.4
34.0	3.659	0.815	113.5	26.3
36.0	3.616	0.854	94.5	32.7
39.0	3.659	0.877	84.6	37.9
42.0	3.659	0.898	71.9	45.7
45.0	3.616	0.920	67.4	49.4
50.0	3.659	0.941	45.5	75.7
55.0	3.534	0.959	39.4	86.0
60.0	3.616	0.961	34.7	100.2
65.0	3.344	0.974	26.0	125.3
70.0	3.456	0.983	18.4	184.7
80.0	3.418	0.987	15.1	223.4
90.0	3.206	0.988	10.5	301.7
100.0	2.962	0.995	4.7	627.3

x = 1000mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.990	0.042	83.8	1.5
9.0	2.827	0.064	105.7	1.7
12.0	3.079	0.141	161.7	2.7
14.0	3.206	0.201	171.2	3.8
16.0	3.309	0.312	193.2	5.4
18.0	3.380	0.442	203.3	7.3
20.0	3.418	0.555	184.6	10.3
22.0	3.456	0.637	176.1	12.5
24.0	3.456	0.724	152.4	16.4
26.0	3.418	0.750	147.7	17.3
28.0	3.494	0.806	120.4	23.4
30.0	3.456	0.855	102.8	28.8
35.0	3.380	0.888	89.8	33.4
40.0	3.418	0.917	68.6	45.7
45.0	3.344	0.952	43.8	72.7
50.0	3.141	0.938	47.8	61.7
55.0	3.173	0.947	45.3	66.4
60.0	2.880	0.958	32.6	84.6
65.0	2.880	0.970	26.5	105.4
70.0	2.681	0.971	23.4	111.3
75.0	2.728	0.971	25.0	106.0
80.0	2.570	0.978	17.6	142.8
85.0	2.528	0.966	22.7	107.6
90.0	2.528	0.975	19.0	129.7
100.0	2.392	0.981	13.3	176.5
110.0	2.392	0.992	7.8	304.2
120.0	2.430	0.996	3.4	711.7

x = 1000mm, y = 100mm Exp. DT3 Q_w = 26.3L/s D = 46mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.907	0.035	76.5	1.3
9.0	2.962	0.057	105.8	1.6
12.0	2.934	0.090	140.5	1.9
15.0	3.240	0.192	169.8	3.7
18.0	3.173	0.302	214.9	4.5
21.0	3.309	0.448	203.3	7.3
24.0	3.274	0.488	205.5	7.8
27.0	3.309	0.586	205.5	9.4
30.0	3.274	0.676	171.3	12.9
35.0	3.309	0.788	141.5	18.4
40.0	3.274	0.844	110.2	25.1

x = 1000mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
6.0	2.613	0.017	46.3	1.0
10.0	2.853	0.029	72.8	1.2
15.0	2.880	0.039	92.7	1.2
20.0	2.827	0.067	120.2	1.6
25.0	2.802	0.079	131.2	1.7
30.0	2.990	0.104	148.6	2.1
35.0	3.019	0.173	173.0	3.0
40.0	3.110	0.232	182.2	4.0
45.0	3.079	0.273	204.3	4.1
50.0	3.110	0.319	195.2	5.1
55.0	3.019	0.382	198.8	5.8

45.0	3.173	0.880	87.1	32.1
50.0	3.173	0.891	85.3	33.1
55.0	3.079	0.915	67.7	41.6
60.0	2.962	0.907	71.2	37.7
65.0	2.907	0.902	72.8	36.0
70.0	2.853	0.915	63.7	41.0
75.0	2.853	0.924	55.4	47.6
80.0	2.752	0.907	67.4	37.0
85.0	2.728	0.916	56.2	44.5
90.0	2.658	0.908	63.5	38.0
95.0	2.636	0.934	47.7	51.6
100.0	2.528	0.916	55.7	41.6
105.0	2.592	0.934	44.8	54.0
110.0	2.549	0.950	33.2	73.0
120.0	2.592	0.972	17.8	141.6
130.0	2.449	0.983	10.4	231.4
140.0	2.356	0.995	3.9	601.0
150.0	2.508	0.997	1.4	1786.9

60.0	2.990	0.354	206.2	5.1
65.0	3.019	0.381	196.1	5.9
70.0	2.990	0.479	186.7	7.7
75.0	2.853	0.478	192.4	7.1
80.0	2.752	0.511	187.5	7.5
85.0	2.658	0.481	180.9	7.1
90.0	2.549	0.519	161.0	8.2
95.0	2.613	0.697	122.5	14.9
100.0	2.613	0.737	112.8	17.1
105.0	2.592	0.786	83.9	24.3
110.0	2.549	0.823	86.8	24.2
115.0	2.613	0.874	63.5	36.0
120.0	2.528	0.926	38.7	60.5
130.0	2.728	0.977	15.1	176.5
140.0	2.704	0.989	6.3	424.6
150.0	2.392	0.998	1.8	1325.7

x = 1200mm, y = 0mm		Exp. DT3		Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.880	0.007	22.2	1.0	2	19.0	542.8
10.0	2.934	0.013	39.9	1.0	4	38.3	660.5
13.0	2.880	0.028	60.3	1.4	6	40.0	744.1
16.0	2.962	0.042	80.1	1.6	8	39.0	791.4
18.0	3.079	0.098	113.7	2.7	10	36.9	815.1
20.0	3.173	0.182	134.0	4.3	12	32.6	815.0
22.0	3.344	0.308	151.5	6.8	14	27.2	816.0
24.0	3.418	0.436	167.3	8.9	16	22.3	806.0
26.0	3.494	0.619	139.3	15.5	18	13.5	754.2
28.0	3.494	0.747	122.7	21.3	20	9.2	618.5
30.0	3.534	0.819	99.9	29.0	22	8.2	585.8
32.0	3.494	0.899	61.2	51.4	24	6.6	437.6
34.0	3.494	0.946	43.3	76.4			
36.0	3.494	0.957	35.3	94.7			
38.0	3.456	0.957	34.1	97.0			
40.0	3.344	0.970	26.8	121.0			
42.0	3.534	0.977	19.7	175.2			
44.0	3.494	0.980	18.9	181.2			
47.0	3.418	0.984	15.8	212.8			
50.0	3.534	0.989	11.5	303.8			
55.0	3.418	0.992	7.6	445.9			
60.0	3.380	0.991	8.8	380.7			
70.0	3.456	0.996	5.1	674.7			

80.0	3.380	0.998	2.6	1297.1
90.0	3.049	0.997	2.5	1216.1

x = 1200mm, y = 25mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.880	0.010	31.2	0.9	2	20.1	564.5
10.0	3.079	0.017	47.9	1.1	4	17.5	710.3
13.0	3.141	0.030	68.1	1.4	6	33.5	768.5
16.0	2.853	0.046	90.5	1.5	8	35.3	773.0
18.0	2.990	0.072	110.6	2.0	10	36.2	804.9
20.0	2.990	0.084	111.0	2.3	12	32.8	813.8
22.0	3.274	0.181	145.2	4.1	14	29.0	808.2
24.0	3.274	0.213	159.8	4.4	16	26.6	809.1
26.0	3.418	0.357	184.5	6.6	18	21.9	787.7
28.0	3.418	0.493	163.9	10.3	20	15.2	725.8
30.0	3.456	0.661	139.2	16.4	22	10.8	657.0
32.0	3.418	0.772	112.9	23.4	24	9.8	624.8
34.0	3.456	0.860	89.0	33.4	26	6.9	457.5
36.0	3.534	0.886	70.8	44.2	28	5.8	360.8
38.0	3.456	0.927	56.9	56.3			
40.0	3.494	0.938	46.3	70.8			
42.0	3.616	0.951	37.9	90.8			
44.0	3.575	0.954	32.7	104.3			
47.0	3.575	0.967	25.6	135.0			
50.0	3.534	0.968	24.3	140.8			
55.0	3.575	0.985	14.4	244.5			
60.0	3.380	0.990	10.9	307.2			
70.0	3.456	0.994	6.6	520.2			
80.0	3.659	0.998	2.8	1304.1			
90.0	3.019	0.998	1.9	1585.9			

x = 1200mm, y = 50mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.853	0.009	26.9	0.9	2	18.7	573.3
10.0	2.934	0.021	49.6	1.2	4	15.9	699.8
13.0	2.962	0.041	83.0	1.5	6	30.6	756.9
16.0	2.962	0.072	118.2	1.8	8	30.1	798.1
18.0	2.990	0.098	137.6	2.1	10	34.5	810.5
20.0	3.206	0.185	172.1	3.4	12	37.1	809.5
22.0	3.206	0.243	196.7	4.0	14	34.6	788.6
24.0	3.344	0.385	220.1	5.9	16	32.5	777.7
26.0	3.274	0.455	220.6	6.8	18	29.2	745.8
28.0	3.380	0.590	201.3	9.9	20	24.9	697.8

30.0	3.418	0.696	182.5	13.0	22	19.3	582.1
32.0	3.380	0.781	163.7	16.1	24	15.3	498.9
34.0	3.494	0.855	123.0	24.3	26	10.9	421.0
36.0	3.494	0.881	98.4	31.3			
38.0	3.380	0.915	81.0	38.2			
40.0	3.309	0.931	64.0	48.1			
42.0	3.494	0.944	52.7	62.6			
44.0	3.534	0.952	41.6	80.9			
47.0	3.534	0.968	30.0	114.0			
50.0	3.534	0.971	27.4	125.2			
55.0	3.702	0.982	17.6	206.5			
60.0	3.380	0.985	11.9	279.9			
70.0	3.534	0.990	8.5	411.5			
80.0	3.240	0.996	4.0	807.1			
90.0	2.681	0.997	2.3	1162.5			

x = 1200mm, y = 75mm			Exp. DT3	Q_w = 26.3L/s		D = 46mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.681	0.011	28.5	1.1	2	25.6	522.7
10.0	2.907	0.014	32.7	1.2	4	25.1	632.0
13.0	2.962	0.031	66.6	1.4	6	23.6	687.7
16.0	2.907	0.061	110.6	1.6	8	33.3	717.9
18.0	2.853	0.085	130.7	1.9	10	34.3	718.7
20.0	2.962	0.123	148.0	2.5	12	35.8	744.6
22.0	2.962	0.198	196.0	3.0	14	34.5	751.3
24.0	2.907	0.237	225.3	3.1	16	31.0	711.8
26.0	3.049	0.302	240.2	3.8	18	27.1	674.0
28.0	3.079	0.408	258.6	4.9	20	24.3	636.2
30.0	3.173	0.580	241.5	7.6	22	20.5	583.9
32.0	3.110	0.653	225.8	9.0	24	17.1	517.2
34.0	3.110	0.654	240.7	8.5	26	13.7	450.3
36.0	3.079	0.718	221.8	10.0	28	11.1	364.7
38.0	3.019	0.824	159.2	15.6			
40.0	2.990	0.839	142.9	17.6			
42.0	2.962	0.872	131.8	19.6			
44.0	2.990	0.892	117.8	22.7			
47.0	2.934	0.945	65.8	42.1			
50.0	2.990	0.943	65.1	43.3			
55.0	2.934	0.964	39.1	72.3			
60.0	2.752	0.968	28.7	92.8			
70.0	2.962	0.977	18.6	155.5			
80.0	2.802	0.983	11.2	246.0			
90.0	3.173	0.995	4.6	686.1			

x = 1200mm, y = 100mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.549	0.004	11.9	0.9	2	42.7	445.8
10.0	2.636	0.007	19.4	1.0	4	42.6	426.8
15.0	2.802	0.030	65.6	1.3	6	38.0	526.6
20.0	2.802	0.047	91.7	1.4	8	37.6	573.8
25.0	2.853	0.080	133.8	1.7	10	34.9	606.9
30.0	2.827	0.143	170.1	2.4	12	36.3	642.2
33.0	2.827	0.179	219.0	2.3	14	35.7	671.4
36.0	2.752	0.205	218.2	2.6	16	36.7	690.1
39.0	2.827	0.261	236.1	3.1	18	33.3	669.2
42.0	2.880	0.320	251.6	3.7	20	34.2	693.1
45.0	2.853	0.454	247.5	5.2	22	31.3	679.4
48.0	2.907	0.590	212.9	8.1	24	29.2	663.5
51.0	2.907	0.660	196.6	9.8	26	26.2	647.6
54.0	2.853	0.780	135.3	16.5	28	23.7	636.5
57.0	2.853	0.823	115.9	20.2	30	20.1	598.0
60.0	2.777	0.862	86.6	27.6	33	17.4	599.3
63.0	2.880	0.894	69.2	37.2	36	13.1	533.9
66.0	2.990	0.898	62.1	43.2	39	9.8	449.4
70.0	3.019	0.929	45.4	61.8	42	6.8	392.7
75.0	2.827	0.939	39.5	67.2	45	6.0	352.1
80.0	2.907	0.941	36.1	75.7			
85.0	2.752	0.960	25.8	102.4			
90.0	2.777	0.975	15.9	170.2			
100.0	2.907	0.984	9.5	301.0			
110.0	2.802	0.996	3.0	930.2			

x = 1200mm, y = 120mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
6.0	2.488	0.006	15.1	0.9	2	51.2	458.7
10.0	2.613	0.010	26.6	1.0	4	50.0	537.3
15.0	2.636	0.018	45.7	1.1	6	46.4	577.1
20.0	2.658	0.023	49.9	1.2	8	46.4	599.2
25.0	2.613	0.021	40.6	1.3	10	44.6	619.7
30.0	2.145	0.027	40.1	1.5	12	42.6	643.2
33.0	2.130	0.042	58.7	1.5	14	39.4	629.2
36.0	2.237	0.068	76.6	2.0	16	38.8	637.1
39.0	2.321	0.134	123.5	2.5	18	35.8	621.1
42.0	2.411	0.211	144.3	3.5	20	35.9	602.9
45.0	2.488	0.308	176.2	4.4	22	34.3	587.6
48.0	2.592	0.429	173.2	6.4	24	31.6	539.8
51.0	2.658	0.524	181.7	7.7	26	32.6	543.3

54.0	2.853	0.633	154.4	11.7	28	30.6	486.8		
57.0	2.990	0.713	134.2	15.9	30	29.1	464.9		
60.0	3.173	0.768	119.2	20.4	33	25.9	429.0		
63.0	3.079	0.783	107.7	22.4	36	19.7	401.4		
66.0	3.110	0.822	90.2	28.4	39	14.3	373.2		
70.0	3.173	0.881	66.9	41.8	42	11.1	362.6		
75.0	2.907	0.912	53.6	49.5	45	7.8	346.8		
80.0	3.110	0.935	40.9	71.1	48	-18.4	344.2		
85.0	3.049	0.966	23.9	123.2					
90.0	3.079	0.956	27.1	108.6					
100.0	3.494	0.993	4.2	825.9					
110.0	2.613	0.990	7.5	345.0					

x = 1800mm, y = 0mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm			x = 1800mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.880	0.002	4.9	1.2	10.0	3.019	0.004	9.6	1.2
20.0	2.990	0.023	43.9	1.6	20.0	2.934	0.041	72.3	1.7
25.0	2.934	0.051	89.2	1.7	24.0	2.934	0.076	122.9	1.8
30.0	3.019	0.090	140.8	1.9	27.0	2.934	0.105	163.3	1.9
35.0	3.110	0.145	201.8	2.2	30.0	2.962	0.146	201.2	2.2
38.0	3.141	0.179	224.9	2.5	33.0	3.049	0.244	267.5	2.8
40.0	3.206	0.238	248.7	3.1	36.0	3.110	0.321	304.3	3.3
42.0	3.240	0.320	272.2	3.8	39.0	3.274	0.431	333.2	4.2
44.0	3.274	0.403	289.7	4.6	42.0	3.344	0.521	346.2	5.0
46.0	3.344	0.478	287.8	5.5	45.0	3.380	0.633	309.7	6.9
48.0	3.380	0.593	285.8	7.0	48.0	3.456	0.748	264.7	9.8
50.0	3.380	0.702	231.7	10.2	51.0	3.380	0.776	245.4	10.7
52.0	3.380	0.755	204.9	12.5	54.0	3.456	0.858	176.6	16.8
54.0	3.380	0.837	171.8	16.5	57.0	3.456	0.903	121.7	25.6
56.0	3.380	0.876	133.2	22.2	60.0	3.456	0.951	74.2	44.3
58.0	3.344	0.916	102.3	29.9	63.0	3.456	0.964	52.4	63.5
60.0	3.380	0.932	90.8	34.7	66.0	3.494	0.986	23.3	147.9
62.0	3.380	0.959	53.8	60.3	70.0	3.494	0.990	16.0	216.2
65.0	3.380	0.969	43.7	75.0	75.0	3.534	0.997	4.8	734.4
70.0	3.380	0.990	16.6	201.5	80.0	3.344	0.998	2.5	1335.5
75.0	3.456	0.997	5.5	626.2					
80.0	3.534	0.999	2.1	1681.5					
90.0	3.575	1.000	1.2	2978.0					

x = 1800mm, y = 50mm		Exp. DT3	Q_w = 26.3L/s		D = 46mm			x = 1800mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.777	0.002	5.2	1.1	10.0	2.728	0.001	2.4	1.0
18.0	2.880	0.019	35.0	1.5	20.0	2.704	0.011	20.5	1.4

23.0	2.880	0.034	55.5	1.8
26.0	2.880	0.083	107.8	2.2
28.0	2.934	0.111	120.8	2.7
30.0	3.079	0.191	166.9	3.5
32.0	3.206	0.373	220.5	5.4
34.0	3.309	0.525	246.1	7.1
36.0	3.309	0.673	210.6	10.6
38.0	3.309	0.790	176.1	14.8
40.0	3.344	0.835	160.6	17.4
42.0	3.456	0.873	127.5	23.7
44.0	3.494	0.916	88.4	36.2
47.0	3.534	0.942	72.5	45.9
50.0	3.534	0.968	41.6	82.2
55.0	3.494	0.981	28.8	119.0
60.0	3.659	0.991	11.2	323.8
65.0	3.575	0.995	8.8	404.1
70.0	3.494	0.998	3.7	942.1
80.0	2.827	1.000	0.4	7066.9

23.0	2.592	0.021	31.9	1.7
25.0	2.681	0.037	49.0	2.0
26.0	2.728	0.065	66.0	2.7
27.0	3.079	0.125	97.0	4.0
28.0	3.079	0.119	94.1	3.9
29.0	3.173	0.229	140.8	5.2
30.0	3.173	0.279	151.1	5.9
31.0	3.240	0.387	172.7	7.3
32.0	3.206	0.504	166.1	9.7
33.0	3.274	0.590	178.0	10.9
34.0	3.274	0.711	150.3	15.5
35.0	3.274	0.776	128.1	19.8
36.0	3.344	0.848	94.4	30.0
37.0	3.309	0.885	73.1	40.1
38.0	3.344	0.932	54.4	57.3
40.0	3.344	0.975	25.5	127.9
45.0	3.456	0.995	7.8	440.7
50.0	4.092	0.999	1.9	2151.8

x = 1800mm, y = 100mm   Exp. DT3 Q_w = 26.3L/s D = 46mm x = 1800mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.549	0.003	7.4	1.0
20.0	2.570	0.026	41.6	1.6
23.0	2.592	0.038	55.3	1.8
25.0	2.728	0.091	90.2	2.8
26.0	2.704	0.112	97.8	3.1
27.0	2.880	0.186	130.5	4.1
28.0	2.990	0.227	137.4	4.9
29.0	2.962	0.275	148.8	5.5
30.0	3.049	0.379	175.6	6.6
31.0	3.049	0.457	187.8	7.4
32.0	3.141	0.608	165.2	11.6
33.0	3.110	0.714	160.8	13.8
34.0	3.173	0.761	124.1	19.5
35.0	3.173	0.845	99.7	26.9
36.0	3.173	0.890	85.5	33.0
37.0	3.206	0.925	62.2	47.7
38.0	3.173	0.961	41.1	74.2
39.0	3.141	0.965	31.1	97.5
40.0	3.206	0.980	17.7	177.4
42.0	3.206	0.992	10.0	318.0
45.0	3.206	0.999	2.4	1334.3

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.356	0.008	15.2	1.2
16.0	2.392	0.023	38.8	1.4
20.0	2.411	0.041	61.6	1.6
22.0	2.430	0.054	75.3	1.8
24.0	2.449	0.071	90.0	1.9
26.0	2.468	0.119	125.5	2.3
27.0	2.528	0.162	149.8	2.7
28.0	2.528	0.187	170.7	2.8
29.0	2.592	0.263	180.1	3.8
30.0	2.549	0.328	205.5	4.1
31.0	2.613	0.411	200.1	5.4
32.0	2.613	0.439	208.7	5.5
33.0	2.613	0.504	206.9	6.4
34.0	2.658	0.578	216.2	7.1
35.0	2.704	0.656	195.9	9.1
36.0	2.658	0.743	174.0	11.4
37.0	2.752	0.793	144.5	15.1
38.0	2.777	0.832	117.7	19.6
40.0	2.752	0.905	81.1	30.7
42.0	2.853	0.948	51.5	52.5
45.0	2.962	0.983	15.9	183.1
50.0	2.934	0.999	1.8	1628.4

Table I-6 Double-tip conductivity probe data: Experiment DT4

x = -150mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
23.00	2.206	0.025	2.9	18.7	2	53.6	825.5
23.25	1.628	0.021	3.2	10.9	4	50.4	802.6
23.50	2.658	0.083	6.2	35.4	6	50.5	875.0
23.75	2.411	0.085	10.4	19.7	8	52.9	939.3
24.00	1.819	0.139	13.7	18.5	10	50.9	962.8
24.25	2.853	0.407	24.7	47.0	12	48.2	965.8
24.50	3.141	0.588	34.8	53.1	14	42.9	964.3
24.75	3.937	0.895	15.2	231.8	16	38.7	965.0
25.00	5.016	0.926	8.9	521.9	18	32.6	963.7
25.25	2.880	0.954	8.8	312.2	20	25.0	964.6
25.50	1.968	0.951	3.0	623.6	22	17.3	958.9
					24	7.4	899.8

x = -150mm, y = 25mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
21.00	0.997	0.016	2.5	6.2	2	53.5	925.2
21.50	2.488	0.136	11.1	30.5	4	51.8	909.7
22.00	2.374	0.168	11.3	35.4	6	50.6	962.3
22.25	3.110	0.350	18.6	58.6	8	49.5	970.0
22.50	3.937	0.474	23.5	79.5	10	47.2	971.8
22.75	2.033	0.498	28.6	35.4	12	43.9	972.1
23.00	5.016	0.520	21.2	123.0	14	39.0	971.0
23.25	3.840	0.828	17.9	177.5	16	34.8	970.6
23.50	2.356	0.834	15.4	127.6	18	28.0	970.4
23.75	3.888	0.929	9.9	364.7	20	18.9	959.9
24.00	4.859	0.940	11.5	397.3	22	8.5	480.3
24.50	5.016	0.977	3.1	1580.2	24	5.0	186.6

x = -150mm, y = 50mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
22.50	3.141	0.015	2.9	15.8	2	54.4	948.1
23.00	2.853	0.058	12.3	13.3	4	52.3	943.1
23.25	3.494	0.063	11.7	18.9	6	51.0	972.9
23.50	2.449	0.084	14.3	14.3	8	50.2	975.3
23.75	3.987	0.291	44.4	26.1	10	48.0	974.3
24.00	3.702	0.537	45.2	44.0	12	46.1	975.1
24.25	3.049	0.594	36.5	49.6	14	41.9	974.5
24.50	4.319	0.813	26.9	130.6	16	36.1	973.3
24.75	4.443	0.939	14.3	291.8	18	29.2	971.6

25.00	4.859	0.987	3.2	1498.9	20	20.3	969.3
25.50	3.888	0.998	0.5	7758.5	22	9.2	870.5
					24	6.8	196.2

x = -150mm, y = 75mm		Exp. DT4	Q_w = 20.7L/s	D = 35mm			
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
22.00	3.141	0.033	10.1	10.2	2	55.2	877.3
22.50	2.528	0.078	31.4	6.3	4	52.6	886.1
23.00	3.079	0.275	91.1	9.3	6	53.5	927.9
23.25	2.990	0.394	105.8	11.1	8	52.2	966.4
23.50	3.380	0.557	97.1	19.4	10	49.5	965.0
23.75	3.274	0.750	81.8	30.0	12	46.7	975.4
24.00	3.110	0.866	61.9	43.5	14	42.2	975.7
24.25	2.934	0.955	21.0	133.5	16	34.7	975.1
24.50	3.240	0.949	26.1	117.7	18	27.5	976.2
24.75	3.456	0.965	12.6	264.6	20	18.9	973.1
25.00	3.494	0.986	7.8	441.6	22	9.0	876.1
25.50	2.990	0.999	1.2	2488.4	24	7.7	220.7

x = -150mm, y = 100mm		Exp. DT4	Q_w = 20.7L/s	D = 35mm			
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
18.00	2.880	0.009	20.6	1.3	2	55.5	761.6
20.00	3.110	0.101	99.4	3.2	4	54.3	794.5
21.00	3.309	0.205	145.6	4.7	6	54.2	851.8
21.50	3.418	0.230	146.4	5.4	8	53.4	927.2
22.00	3.344	0.343	166.2	6.9	10	50.4	933.0
22.50	3.456	0.562	165.2	11.8	12	46.0	953.9
23.00	3.456	0.635	162.9	13.5	14	41.7	941.9
23.50	3.418	0.821	103.0	27.3	16	34.8	932.6
24.00	3.456	0.904	82.3	38.0	18	28.0	928.9
24.50	3.494	0.926	70.0	46.2	20	20.5	831.9
25.50	3.494	0.963	45.9	73.3	22	12.1	644.6
27.50	3.616	0.998	5.8	622.4	24	9.0	329.5

x = -150mm, y = 115mm		Exp. DT4	Q_w = 20.7L/s	D = 35mm			
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
18.00	2.636	0.007	13.1	1.4	2	57.0	632.5
19.50	2.681	0.023	31.1	2.0	4	54.4	654.4
20.50	2.508	0.063	60.0	2.6	6	57.8	680.2
21.00	3.141	0.166	108.1	4.8	8	60.0	731.0
21.50	2.934	0.225	118.8	5.5	10	58.2	822.3

22.00	3.079	0.442	153.2	8.9	12	50.2	862.3
22.50	3.049	0.550	160.1	10.5	14	46.1	870.7
23.00	3.110	0.664	136.7	15.1	16	38.1	850.0
23.50	3.141	0.822	95.4	27.1	18	29.1	830.5
24.00	3.173	0.863	84.1	32.6	20	19.3	744.2
25.00	3.206	0.950	36.4	83.7	22	10.0	628.0
27.00	3.240	0.995	5.6	575.7	24	7.9	399.6

x = 0mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
166.00	3.173	0.012	1.9	19.8	145.5	10.3	634.0
166.50	3.141	0.044	5.2	26.7	147.5	13.8	706.7
166.75	3.616	0.044	6.7	23.8	149.5	18.6	813.8
167.00	3.344	0.225	24.1	31.3	151.5	22.8	894.9
167.25	3.173	0.466	36.4	40.6	153.5	25.3	940.5
167.50	3.141	0.546	47.0	36.5	155.5	26.1	959.1
167.75	2.934	0.635	52.5	35.5	157.5	25.3	969.4
168.00	3.173	0.826	26.4	99.3	159.5	23.1	972.5
168.25	2.508	0.923	25.1	92.2	161.5	20.4	974.5
168.50	2.704	0.995	4.0	672.9	163.5	16.1	973.4
					165.5	9.2	952.3
					167.5	4.9	542.3

x = 25mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
142.25	2.880	0.996	8.7	329.7	143	7.3	492.1
142.50	2.907	0.987	26.6	107.8	145	11.2	645.7
142.75	2.880	0.954	78.7	34.9	147	15.5	740.4
143.00	2.880	0.828	212.0	11.2	149	19.6	830.5
143.25	2.880	0.615	317.2	5.6	151	22.9	867.7
143.50	2.880	0.319	297.1	3.1	153	25.6	928.5
143.75	2.907	0.153	202.5	2.2	155	26.5	963.3
144.00	2.962	0.051	97.2	1.6	157	25.2	969.1
144.25	2.934	0.015	35.2	1.3	159	22.5	973.5
165.50	2.934	0.011	3.8	8.9	161	20.1	973.8
166.00	2.449	0.018	4.7	9.4	163	15.8	972.9
166.25	2.934	0.074	16.1	13.5	165	10.3	970.8
166.50	2.907	0.120	21.2	16.5	167	5.0	674.4
166.75	2.990	0.252	36.1	20.8			
167.00	3.019	0.524	55.7	28.4			
167.25	3.240	0.824	38.5	69.3			
167.50	2.934	0.932	25.7	106.4			
167.75	3.049	0.969	8.3	356.0			

168.00	3.344	0.996	1.1	3028.5
168.50	2.728	0.999	0.5	5452.7

x = 50mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
140.50	2.907	0.995	7.1	407.5	142	7.4	486.0
141.00	2.990	0.980	29.2	100.4	144	11.2	631.4
141.50	3.019	0.892	111.9	24.1	146	15.1	734.3
141.75	2.962	0.808	174.7	13.7	148	20.2	815.9
142.00	3.019	0.669	241.9	8.3	150	23.5	880.8
142.25	2.990	0.525	263.3	6.0	152	25.6	926.4
142.50	3.019	0.362	255.5	4.3	154	26.3	940.9
142.75	3.019	0.200	187.7	3.2	156	25.1	969.2
143.00	3.049	0.143	154.3	2.8	158	22.4	971.3
143.50	3.079	0.029	48.4	1.9	160	19.9	973.0
144.00	3.049	0.004	9.9	1.3	162	15.8	973.1
164.25	2.990	0.040	8.0	15.1	164	9.2	946.5
164.75	2.827	0.044	7.7	16.0	166	4.2	502.2
165.00	2.934	0.059	9.0	19.3			
165.25	3.110	0.100	14.5	21.5			
165.50	3.141	0.314	33.5	29.4			
165.75	3.141	0.325	37.2	27.4			
166.00	3.494	0.574	51.0	39.3			
166.25	2.827	0.825	33.8	69.0			
166.50	3.019	0.868	26.5	98.9			
166.75	3.309	0.947	14.3	219.1			
167.00	3.309	0.978	6.6	490.3			
167.50	3.747	0.998	2.0	1868.9			

x = 100mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
136.00	3.049	0.995	5.6	541.8	138	4.9	397.7
137.00	3.110	0.949	45.8	64.4	140	7.7	617.4
137.50	3.079	0.860	103.3	25.6	142	13.8	706.7
138.00	3.110	0.742	151.2	15.3	144	18.0	785.9
138.50	3.110	0.563	192.2	9.1	146	21.6	837.4
139.00	3.110	0.350	183.3	5.9	148	24.9	906.5
139.50	3.141	0.209	147.2	4.5	150	26.2	955.5
140.00	3.141	0.107	96.0	3.5	152	25.8	954.0
140.50	3.141	0.048	51.5	2.9	154	23.6	969.7
141.50	3.141	0.004	5.5	2.2	156	20.8	972.4
160.25	2.728	0.017	2.9	16.1	158	16.5	973.2
160.75	2.990	0.020	4.1	14.8	160	11.0	962.3

161.25	2.636	0.051	6.7	20.0	162	4.5	891.5
161.50	3.380	0.046	7.4	21.0			
161.75	3.380	0.031	8.7	12.1			
162.00	3.494	0.219	30.8	24.9			
162.25	3.240	0.436	35.2	40.1			
162.50	2.853	0.515	51.0	28.8			
162.75	3.019	0.674	38.7	52.6			
163.00	2.880	0.795	31.9	71.8			
163.25	3.049	0.843	36.5	70.4			
163.50	3.309	0.946	13.3	235.4			
164.00	3.575	0.984	5.7	616.9			
164.50	4.574	0.997	0.8	5699.9			

x = 200mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
120.0	2.962	0.999	0.8	3699.3	126	4.1	503.1
122.0	3.173	0.988	9.0	348.2	128	8.7	637.9
123.0	3.173	0.957	27.4	110.8	130	14.4	713.9
124.0	3.173	0.868	69.7	39.5	132	15.4	758.9
125.0	3.173	0.734	112.6	20.7	134	21.0	814.8
126.0	3.206	0.470	143.8	10.5	136	24.1	840.9
127.0	3.240	0.255	113.6	7.3	138	25.7	913.8
128.0	3.173	0.171	86.3	6.3	140	25.5	943.7
129.0	3.206	0.050	36.9	4.4	142	23.7	955.1
130.0	3.274	0.015	11.9	4.0	144	20.7	967.6
132.0	3.110	0.003	2.6	3.7	146	16.5	971.4
148.0	3.019	0.029	3.3	26.5	148	11.3	957.5
149.0	2.592	0.010	1.5	17.4	150	5.4	925.9
149.5	2.962	0.014	2.6	15.5	152	2.7	410.5
150.0	2.752	0.075	16.5	12.6			
150.5	3.534	0.196	23.5	29.5			
151.0	3.418	0.408	45.1	30.9			
151.5	3.173	0.590	50.3	37.2			
152.0	3.206	0.887	24.3	117.1			
152.5	3.747	0.937	16.0	219.4			
153.0	3.049	0.989	3.7	815.3			
153.5	3.309	0.987	2.9	1126.2			

x = 300mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
97.0	3.141	0.999	1.1	2852.2	106	3.2	524.8
100.0	3.206	0.988	7.1	446.1	108	4.3	612.7
102.0	3.274	0.934	30.5	100.2	110	7.8	703.0

103.0	3.274	0.833	56.3	48.4	112	12.5	756.2
104.0	3.309	0.701	92.8	25.0	114	17.9	790.3
105.0	3.274	0.605	98.4	20.1	116	21.8	830.2
106.0	3.309	0.505	101.8	16.4	118	24.5	871.9
107.0	3.309	0.348	97.3	11.8	120	25.9	905.4
108.0	3.309	0.246	90.2	9.0	122	24.4	933.8
109.0	3.309	0.168	60.2	9.2	124	21.9	952.9
110.0	3.274	0.035	23.4	4.9	126	18.3	963.7
112.0	3.344	0.014	8.4	5.4	128	12.6	965.8
115.0	3.418	0.010	5.6	5.9	130	7.5	876.3
130.0	2.752	0.011	2.6	11.3	132	2.2	786.3
131.0	3.240	0.073	10.2	23.0	134	1.6	231.8
131.5	3.019	0.084	14.3	17.7			
132.0	2.880	0.137	23.9	16.5			
132.5	3.274	0.260	41.3	20.6			
133.0	3.380	0.341	46.0	25.1			
133.5	3.240	0.638	43.7	47.3			
134.0	3.456	0.787	36.9	73.7			
134.5	3.494	0.920	19.1	168.3			
135.5	3.747	0.990	3.7	1002.3			
135.0	3.616	0.970	7.8	449.9			
136.0	3.534	0.993	1.1	3191.5			

x = 400mm, y = 0mm			Exp. DT4		Q_w = 20.7L/s	D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
66.0	3.274	0.996	1.9	1716.2	75	-2.7	191.1
69.0	3.344	0.980	8.1	404.4	77	-2.3	338.5
71.0	3.309	0.937	23.1	134.1	79	-1.9	460.3
73.0	3.344	0.843	43.6	64.6	81	-1.3	570.8
75.0	3.380	0.555	79.1	23.7	83	-0.4	569.4
76.0	3.380	0.485	76.1	21.6	85	2.7	684.3
77.0	3.380	0.648	57.9	37.8	87	4.5	720.5
78.0	3.380	0.450	69.7	21.8	89	8.9	762.8
79.0	3.380	0.248	67.6	12.4	91	8.5	796.2
80.0	3.309	0.183	44.5	13.6	93	12.5	843.8
81.0	3.344	0.119	38.1	10.5	95	12.0	868.5
82.0	3.344	0.181	35.4	17.1	97	16.5	895.0
84.0	3.274	0.068	22.9	9.8	99	16.2	923.1
86.0	3.380	0.087	23.2	12.7	101	10.8	941.1
88.0	3.309	0.040	15.0	8.9	103	10.5	963.2
91.0	3.173	0.004	2.0	6.6	105	5.7	969.3
103.0	2.549	0.004	1.5	7.2	107	-1.1	888.1
105.0	2.827	0.018	3.3	15.1	109	-3.1	659.8
106.0	3.418	0.092	14.7	21.5			

107.0	3.110	0.138	24.8	17.3
108.0	3.418	0.395	47.1	28.7
109.0	3.418	0.624	49.1	43.4
110.0	3.494	0.888	22.0	141.1
112.0	4.319	0.998	1.1	3919.6

x = 400mm, y = 25mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
73.0	3.616	0.993	4.6	781.0	83	0.4	286.1
76.0	3.616	0.978	13.1	270.0	85	1.7	500.7
78.0	3.659	0.925	36.8	92.0	87	4.3	640.8
79.0	3.659	0.898	48.6	67.6	89	4.4	784.1
80.0	3.659	0.814	78.0	38.2	91	8.8	844.3
81.0	3.659	0.758	88.4	31.4	93	11.8	928.4
82.0	3.659	0.645	114.7	20.6	95	13.3	940.2
83.0	3.616	0.564	118.6	17.2	97	11.7	956.9
84.0	3.616	0.384	124.7	11.1	99	7.2	918.1
85.0	3.659	0.296	115.0	9.4	101	6.0	850.2
86.0	3.616	0.219	92.6	8.6	103	1.5	563.6
87.0	3.534	0.216	95.1	8.0	105	-0.6	180.2
89.0	3.575	0.120	54.6	7.9			
90.0	3.494	0.067	32.1	7.3			
92.0	3.456	0.019	10.2	6.4			
96.0	3.616	0.017	11.4	5.4			
100.0	3.380	0.021	6.6	10.6			
101.0	3.575	0.087	12.4	25.1			
102.0	3.659	0.258	31.8	29.7			
103.0	3.575	0.304	26.3	41.3			
104.0	3.575	0.440	35.1	44.8			
105.0	3.659	0.713	31.8	82.1			
106.0	3.274	0.799	20.5	127.5			
107.0	3.380	0.778	20.5	128.3			
108.0	3.456	0.810	14.7	190.5			
110.0	3.309	0.961	4.4	722.5			
112.0	3.987	0.995	1.4	2833.3			

x = 400mm, y = 50mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
73.0	3.534	0.999	1.2	2941.7	83	-0.3	373.2
76.0	3.702	0.981	11.4	318.7	85	1.1	533.4
78.0	3.702	0.938	32.7	106.2	87	2.8	674.1
79.0	3.747	0.881	57.1	57.8	89	7.2	825.0
80.0	3.702	0.851	68.2	46.2	91	11.4	881.6

81.0	3.747	0.780	90.1	32.4	93	14.7	924.9
82.0	3.702	0.634	119.7	19.6	95	15.4	940.3
83.0	3.702	0.548	122.7	16.5	97	14.4	963.2
84.0	3.659	0.423	125.9	12.3	99	11.9	970.1
85.0	3.702	0.277	112.4	9.1	101	9.5	969.1
86.0	3.616	0.197	93.4	7.6	103	3.6	970.0
87.0	3.659	0.116	68.5	6.2	105	-1.8	947.3
88.0	3.616	0.073	46.6	5.6	107	-3.2	869.0
90.0	3.575	0.022	18.4	4.2	109	-3.3	759.0
93.0	3.344	0.008	6.0	4.5	111	-1.9	461.5
102.0	2.392	0.005	1.0	10.8			
106.0	3.173	0.050	8.9	17.8			
108.0	3.344	0.169	22.1	25.5			
109.0	2.962	0.210	26.0	24.0			
110.0	3.274	0.314	29.9	34.3			
111.0	3.616	0.594	32.1	66.9			
112.0	3.575	0.690	26.5	93.1			
113.0	3.380	0.764	23.6	109.5			
114.0	3.702	0.883	13.8	236.8			
116.0	3.575	0.982	4.2	835.5			
120.0	3.616	0.994	1.5	2397.6			

x = 400mm, y = 75mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
66.0	3.309	0.995	2.5	1316.5	82	-0.4	280.8
71.0	3.534	0.988	6.4	545.5	84	0.0	371.0
75.0	3.575	0.950	21.9	155.1	86	1.7	556.1
78.0	3.534	0.790	61.1	45.7	88	3.7	645.8
80.0	3.575	0.699	79.5	31.4	90	10.2	734.3
81.0	3.575	0.646	84.5	27.3	92	7.9	818.7
82.0	3.575	0.500	83.7	21.3	94	13.8	881.1
83.0	3.534	0.347	80.0	15.3	96	18.7	914.6
84.0	3.616	0.466	94.4	17.9	98	18.4	933.6
85.0	3.616	0.362	85.6	15.3	100	19.4	953.6
86.0	3.616	0.299	87.5	12.3	102	16.1	956.8
87.0	3.575	0.243	71.6	12.1	104	9.7	947.3
88.0	3.575	0.154	54.6	10.1	106	6.8	881.2
90.0	3.494	0.077	35.6	7.6	108	1.6	784.2
93.0	3.418	0.019	10.1	6.4	110	0.0	703.6
100.0	3.380	0.006	2.7	7.4	112	-1.2	589.1
104.0	3.494	0.058	14.8	13.7			
107.0	3.309	0.158	27.0	19.4			
108.0	3.309	0.209	30.7	22.5			
109.0	3.456	0.425	37.8	38.9			

110.0	3.456	0.436	46.6	32.3
111.0	3.616	0.476	43.3	39.8
112.0	3.380	0.569	34.8	55.2
113.0	3.575	0.752	34.3	78.4
114.0	3.344	0.898	24.2	124.1
115.0	3.747	0.922	16.6	208.0
119.0	4.039	0.995	1.7	2364.2

x = 400mm, y = 100mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
50.0	3.206	0.904	32.1	90.3	70	-0.6	211.3
55.0	3.274	0.912	31.4	95.1	72	-0.3	329.0
60.0	3.309	0.896	35.7	83.1	74	0.1	373.5
62.0	3.344	0.856	46.9	61.0	76	0.2	476.3
64.0	3.380	0.804	62.2	43.7	78	1.1	544.6
66.0	3.344	0.762	73.3	34.8	80	1.9	650.9
68.0	3.380	0.690	83.9	27.8	82	3.6	682.0
70.0	3.309	0.520	104.7	16.4	84	5.9	733.6
72.0	3.380	0.442	103.6	14.4	86	6.4	772.2
74.0	3.344	0.334	102.7	10.9	88	8.3	797.1
76.0	3.309	0.283	103.4	9.1	90	10.6	818.3
78.0	3.309	0.188	87.8	7.1	92	8.6	824.8
80.0	3.274	0.161	81.9	6.4	94	13.1	829.2
82.0	3.206	0.127	71.5	5.7	96	12.5	829.8
85.0	3.274	0.117	69.1	5.5	98	8.4	786.2
88.0	3.274	0.092	60.2	5.0	100	6.9	718.2
90.0	3.309	0.113	71.2	5.3	102	3.6	583.7
92.0	3.309	0.131	79.1	5.5			
94.0	3.380	0.158	80.4	6.6			
96.0	3.534	0.220	83.5	9.3			
98.0	3.659	0.343	90.5	13.9			
100.0	3.702	0.480	91.5	19.4			
102.0	3.702	0.598	88.7	24.9			
104.0	3.793	0.801	61.4	49.5			
106.0	3.840	0.914	33.2	105.7			
109.0	3.840	0.983	8.0	471.7			
112.0	3.747	0.999	0.8	4679.1			

x = 500mm, y = 0mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
52.0	3.534	0.240	46.1	18.4	48	3.3	602.2
53.0	3.456	0.208	37.9	19.0	50	4.2	658.8
54.0	3.494	0.170	40.2	14.8	52	6.6	708.1

55.0	3.418	0.151	33.6	15.4	54	8.3	685.0
56.0	3.534	0.102	25.5	14.2	56	10.3	763.7
57.0	3.494	0.087	27.3	11.2	58	13.4	822.3
58.0	3.616	0.053	17.2	11.1	60	15.8	846.6
60.0	3.309	0.023	7.9	9.4	62	16.3	870.3
62.0	3.494	0.040	15.4	9.0	64	18.8	902.6
65.0	3.418	0.010	5.0	7.2	66	19.7	917.8
70.0	3.380	0.018	4.8	12.7	68	17.5	928.8
72.0	3.141	0.022	7.1	9.7	70	11.0	933.1
73.0	3.418	0.080	12.2	22.5	72	9.0	874.0
74.0	3.309	0.096	20.3	15.6	74	5.3	786.0
75.0	3.418	0.349	39.3	30.3	76	1.0	496.4
76.0	3.418	0.504	47.8	36.1			
77.0	3.616	0.631	53.5	42.7			
78.0	3.575	0.818	35.4	82.6			
79.0	3.659	0.940	14.0	245.7			
80.0	3.575	0.981	5.9	594.4			
82.0	3.937	0.998	0.6	6549.8			

x = 700mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	3.019	0.032	100.7	1.0	2	27.0	850.0
10.0	3.173	0.044	116.9	1.2	4	21.1	858.6
15.0	3.274	0.064	123.8	1.7	6	19.3	878.9
18.0	3.274	0.059	105.9	1.8	8	18.5	908.6
20.0	3.380	0.075	97.1	2.6	10	16.9	916.8
22.0	3.418	0.176	119.6	5.0	12	15.5	928.0
24.0	3.380	0.373	151.3	8.3	14	21.1	920.5
26.0	3.575	0.495	144.1	12.3	16	27.2	956.9
28.0	3.747	0.631	139.6	16.9	18	28.8	945.9
30.0	3.840	0.751	134.4	21.5	20	25.9	960.9
32.0	3.840	0.840	105.4	30.6	22	17.4	991.7
34.0	3.987	0.874	89.2	39.1	24	11.5	920.0
36.0	3.702	0.914	77.9	43.4	26	7.9	820.2
38.0	3.840	0.925	67.0	53.0			
40.0	4.092	0.957	45.4	86.2			
42.0	4.039	0.964	40.0	97.4			
45.0	3.937	0.975	29.8	128.7			
50.0	3.141	0.986	17.6	176.0			
60.0	2.411	0.998	3.3	729.0			
70.0	2.488	0.998	2.6	955.4			

x = 700mm, y = 25mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.990	0.061	174.7	1.1	2	24.1	796.8
10.0	2.990	0.071	183.1	1.2	4	21.6	808.2
15.0	3.240	0.096	188.8	1.6	6	17.8	807.1
18.0	3.206	0.093	185.0	1.6	8	14.3	798.0
20.0	3.206	0.110	177.7	2.0	10	12.2	773.6
22.0	3.240	0.188	159.5	3.8	12	7.8	765.8
24.0	3.141	0.275	163.9	5.3	14	8.7	781.4
26.0	3.309	0.338	206.6	5.4	16	12.7	784.6
28.0	3.418	0.540	155.1	11.9	18	11.2	819.6
30.0	3.456	0.581	161.9	12.4	20	14.4	814.0
32.0	3.380	0.674	156.4	14.6	22	12.9	829.2
34.0	3.616	0.747	121.4	22.2	24	8.7	815.2
36.0	3.575	0.840	101.9	29.5	26	4.1	731.8
38.0	3.575	0.898	70.4	45.6	28	2.1	675.5
40.0	3.659	0.930	49.6	68.6			
42.0	3.659	0.930	55.5	61.3			
45.0	3.702	0.956	38.0	93.1			
50.0	3.793	0.983	17.3	215.4			
55.0	3.309	0.991	11.5	285.2			
60.0	3.173	0.995	6.9	457.8			
65.0	3.702	0.997	3.8	971.5			
75.0	4.937	0.999	1.4	3522.6			

x = 700mm, y = 50mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	3.019	0.057	145.9	1.2	2	30.4	806.4
10.0	3.240	0.066	145.7	1.5	4	21.9	810.7
15.0	3.456	0.048	97.2	1.7	6	20.0	835.2
17.0	3.418	0.040	76.1	1.8	8	16.1	846.6
18.0	3.659	0.038	62.8	2.2	10	12.3	861.5
19.0	3.494	0.105	62.6	5.8	12	10.9	885.9
20.0	3.418	0.195	76.8	8.7	14	10.3	932.2
21.0	3.344	0.205	79.8	8.6	16	10.7	964.0
22.0	3.309	0.361	70.9	16.8	18	11.2	997.2
23.0	3.380	0.534	71.4	25.3	20	11.9	1014.2
24.0	3.309	0.662	62.9	34.8	22	9.0	933.3
25.0	3.344	0.767	56.1	45.7	24	7.0	794.7
26.0	3.534	0.817	45.1	64.0			
27.0	3.575	0.848	45.1	67.2			
28.0	3.702	0.935	25.5	135.8			
30.0	3.702	0.968	15.9	225.3			

32.0	3.793	0.976	12.9	286.8
35.0	3.937	0.992	7.0	557.7
40.0	4.092	0.998	3.9	1046.9
50.0	4.039	0.998	3.0	1343.4

x = 700mm, y = 75mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	3.141	0.048	119.6	1.3	2	18.9	828.6
10.0	3.380	0.047	91.4	1.7	4	15.1	837.4
14.0	3.575	0.054	87.7	2.2	6	10.8	878.1
16.0	3.702	0.062	70.5	3.3	8	4.3	884.1
17.0	3.659	0.152	88.8	6.3	10	0.6	902.7
18.0	3.659	0.295	79.1	13.7	12	0.6	947.7
19.0	3.575	0.533	79.9	23.8	14	3.3	1004.3
20.0	3.659	0.617	78.8	28.7	16	4.9	1001.7
21.0	3.659	0.791	65.4	44.2	18	6.0	1046.5
22.0	3.702	0.852	46.2	68.3	20	3.4	944.6
23.0	3.840	0.889	43.0	79.4			
24.0	3.659	0.940	29.2	117.8			
25.0	3.793	0.970	21.7	169.5			
26.0	3.840	0.973	17.3	215.8			
27.0	4.039	0.977	13.8	286.0			
28.0	3.888	0.974	15.0	252.3			
30.0	4.147	0.990	7.5	547.4			
35.0	4.319	0.997	2.3	1872.4			
40.0	1.709	0.999	0.9	1896.6			
50.0	1.547	0.999	0.4	3865.1			

x = 700mm, y = 100mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	3.019	0.036	69.7	1.5	2	-3.5	833.7
8.0	3.049	0.055	81.2	2.1	4	-7.1	811.9
10.0	3.456	0.151	121.0	4.3	6	-10.6	883.3
11.0	3.534	0.189	122.5	5.5	8	-8.7	929.5
12.0	3.575	0.357	155.0	8.2	10	-7.8	950.1
13.0	3.494	0.498	150.5	11.6	12	-5.4	949.9
14.0	3.747	0.628	139.4	16.9	14	-1.0	866.6
15.0	3.747	0.726	118.0	23.1			
16.0	3.840	0.773	119.8	24.8			
17.0	3.840	0.802	114.4	26.9			
18.0	3.747	0.845	98.9	32.0			
20.0	3.418	0.871	92.5	32.2			
22.0	2.880	0.891	78.9	32.5			

25.0	1.885	0.918	54.3	31.9
30.0	1.654	0.942	32.7	47.7
35.0	1.628	0.960	23.0	67.9
40.0	1.620	0.953	26.1	59.1
45.0	1.532	0.961	19.4	75.9
50.0	1.637	0.964	18.2	86.7
55.0	1.563	0.965	13.5	111.8
60.0	1.474	0.974	12.3	116.7
70.0	1.495	0.988	6.6	223.9
85.0	1.407	0.997	1.2	1169.4
100.0	1.908	1.000	0.2	9537.5

x = 700mm, y = 120mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.907	0.018	50.6	1.1	2	93.2	641.5
8.0	2.613	0.040	63.7	1.6	4	85.0	648.1
10.0	2.853	0.064	83.4	2.2	6	83.8	762.2
12.0	3.173	0.179	152.4	3.7	8	75.3	825.0
14.0	2.802	0.251	186.8	3.8	10	63.7	855.2
16.0	3.079	0.307	239.5	3.9	12	44.2	842.2
18.0	3.380	0.506	264.2	6.5	14	32.5	764.7
20.0	3.494	0.506	273.7	6.5	16	13.6	705.3
22.0	3.575	0.589	270.9	7.8	18	7.7	618.9
24.0	3.702	0.655	261.1	9.3	20	1.8	563.4
26.0	3.793	0.622	284.4	8.3			
28.0	3.747	0.664	256.8	9.7			
30.0	3.987	0.661	264.3	10.0			
35.0	3.937	0.720	226.2	12.5			
40.0	3.888	0.693	240.0	11.2			
45.0	4.092	0.687	219.5	12.8			
50.0	3.937	0.733	195.8	14.7			
55.0	3.616	0.677	186.6	13.1			
60.0	3.616	0.681	169.2	14.6			
65.0	2.853	0.722	135.7	15.2			
70.0	3.240	0.793	91.8	28.0			
75.0	3.309	0.858	63.5	44.7			
80.0	2.636	0.949	23.4	106.8			
85.0	1.981	0.989	7.5	261.1			
90.0	1.346	0.995	2.8	478.6			
95.0	3.888	0.997	1.7	2279.7			

x = 800mm, *y* = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]	*z* [mm]	*P* [mm]	*H* [mm]
5.0	3.019	0.021	68.9	0.9	2	31.9	843.8
10.0	3.206	0.045	107.9	1.3	4	27.8	884.5
15.0	3.344	0.083	127.6	2.2	6	30.4	930.2
18.0	3.456	0.138	135.1	3.5	8	26.7	917.5
20.0	3.575	0.187	153.1	4.4	10	23.1	929.8
22.0	3.575	0.289	162.4	6.4	12	22.1	938.5
24.0	3.575	0.402	179.5	8.0	14	16.1	939.3
26.0	3.616	0.436	162.8	9.7	16	14.6	939.4
28.0	3.702	0.540	164.5	12.2	18	10.5	899.9
30.0	3.659	0.631	145.1	15.9	20	9.9	872.0
32.0	3.702	0.697	157.5	16.4	22	7.8	803.6
34.0	3.702	0.743	145.5	18.9	24	7.8	820.6
36.0	3.702	0.717	167.5	15.8	26	6.9	724.6
38.0	3.747	0.772	147.9	19.6	28	6.1	644.7
40.0	3.747	0.816	141.4	21.6			
42.0	3.747	0.824	140.1	22.0			
45.0	3.747	0.868	105.8	30.7			
50.0	3.747	0.905	93.2	36.4			
55.0	3.747	0.931	78.3	44.6			
60.0	3.659	0.952	57.5	60.6			
65.0	3.659	0.966	39.3	89.9			
70.0	3.380	0.985	20.1	165.7			
80.0	3.274	0.988	14.6	221.6			
95.0	3.344	0.997	4.1	813.5			
110.0	2.752	0.999	1.4	1964.5			

x = 800mm, *y* = 25mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm			*x* = 800mm, *y* = 50mm	
z [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]	*z* [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]
5.0	2.962	0.049	127.0	1.1	5.0	3.079	0.059	120.3	1.5
9.0	3.079	0.068	147.9	1.4	8.0	3.206	0.073	134.6	1.7
12.0	3.206	0.097	173.5	1.8	10.0	3.274	0.111	157.7	2.3
15.0	3.173	0.129	186.0	2.2	12.0	3.456	0.245	162.6	5.2
18.0	3.274	0.154	194.3	2.6	14.0	3.418	0.315	163.3	6.6
21.0	3.309	0.243	222.1	3.6	16.0	3.494	0.484	166.8	10.1
24.0	3.380	0.302	215.9	4.7	18.0	3.534	0.623	152.4	14.4
27.0	3.418	0.413	207.2	6.8	20.0	3.575	0.635	145.9	15.6
30.0	3.494	0.497	210.2	8.3	22.0	3.575	0.748	138.9	19.2
33.0	3.494	0.566	226.1	8.7	24.0	3.659	0.806	123.7	23.9
36.0	3.494	0.628	208.3	10.5	26.0	3.659	0.836	106.4	28.8
39.0	3.575	0.659	207.8	11.3	28.0	3.616	0.888	96.3	33.4
42.0	3.575	0.694	190.7	13.0	30.0	3.575	0.897	85.9	37.3

45.0	3.534	0.761	168.6	15.9
48.0	3.616	0.818	138.0	21.4
51.0	3.659	0.843	137.9	22.4
55.0	3.702	0.896	92.9	35.7
60.0	3.616	0.937	61.2	55.3
65.0	3.575	0.945	54.1	62.5
70.0	3.456	0.980	24.0	141.1
80.0	3.575	0.990	12.5	283.1
90.0	3.019	0.993	9.1	329.5
100.0	2.880	0.996	5.8	494.4

32.0	3.575	0.914	79.1	41.3
35.0	3.616	0.933	57.2	59.0
40.0	3.575	0.953	55.9	61.0
45.0	3.575	0.956	51.9	65.8
50.0	3.616	0.971	40.7	86.3
60.0	3.380	0.990	15.1	221.6
70.0	3.793	0.992	9.4	400.4
85.0	3.309	0.995	6.2	530.7
100.0	3.888	0.998	2.7	1436.6

x = 800mm, y = 75mm			Exp. DT4		Q_w = 20.7L/s		D = 35mm	x = 800mm, y = 100mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.141	0.070	114.2	1.9	5.0	2.827	0.059	87.9	1.9
7.0	3.141	0.061	102.7	1.9	7.0	3.079	0.055	85.8	2.0
8.0	3.206	0.084	116.9	2.3	8.0	3.141	0.079	94.1	2.7
9.0	3.380	0.094	94.5	3.4	9.0	3.344	0.133	117.5	3.8
10.0	3.456	0.158	127.2	4.3	10.0	3.418	0.218	140.7	5.3
11.0	3.494	0.260	138.6	6.5	11.0	3.418	0.283	161.1	6.0
12.0	3.456	0.382	147.8	8.9	12.0	3.494	0.415	162.8	8.9
13.0	3.534	0.478	161.0	10.5	13.0	3.494	0.521	165.4	11.0
14.0	3.575	0.610	135.8	16.1	14.0	3.575	0.612	151.1	14.5
15.0	3.616	0.690	122.2	20.4	15.0	3.534	0.722	131.9	19.4
16.0	3.659	0.713	135.4	19.3	16.0	3.616	0.755	141.2	19.3
17.0	3.659	0.779	115.1	24.8	17.0	3.616	0.785	132.0	21.5
18.0	3.659	0.854	82.3	38.0	18.0	3.616	0.856	111.0	27.9
20.0	3.702	0.856	89.4	35.4	19.0	3.702	0.854	102.2	30.9
22.0	3.659	0.920	58.0	58.0	20.0	3.702	0.878	90.1	36.1
25.0	3.747	0.951	40.8	87.3	22.0	3.659	0.909	73.2	45.5
30.0	3.616	0.974	26.6	132.5	25.0	3.380	0.933	58.8	53.6
35.0	3.616	0.978	21.5	164.5	30.0	3.456	0.936	55.3	58.5
40.0	3.793	0.991	8.7	432.2	40.0	2.145	0.971	25.7	81.1
50.0	2.752	0.994	6.0	456.1	50.0	2.033	0.966	28.5	68.9
65.0	1.896	0.996	4.3	439.1	60.0	2.087	0.965	29.9	67.4
80.0	1.932	0.997	2.5	770.3	70.0	1.968	0.964	29.7	63.9
					80.0	2.060	0.954	32.3	60.8
					90.0	2.046	0.959	29.6	66.3
					100.0	1.944	0.980	13.0	146.5
					115.0	1.932	0.993	4.1	467.8

x = 800mm, y = 120mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.827	0.008	23.6	0.9	2	567.3	136.4
15.0	2.907	0.032	61.0	1.5	4	573.5	140.5
20.0	3.240	0.154	145.0	3.4	6	648.9	138.5
25.0	3.206	0.268	199.2	4.3	8	719.0	130.9
30.0	3.418	0.499	227.1	7.5	10	778.8	124.4
35.0	3.456	0.564	228.5	8.5	12	809.8	117.7
40.0	3.418	0.643	220.4	10.0	14	835.3	113.8
45.0	3.616	0.701	194.5	13.0	16	838.9	103.3
50.0	3.494	0.693	201.4	12.0	18	802.2	99.2
55.0	3.534	0.735	184.6	14.1	20	765.8	97.1
60.0	3.616	0.751	184.1	14.8	22	704.3	96.4
65.0	3.616	0.765	173.8	15.9	24	668.2	95.3
70.0	3.534	0.778	158.4	17.4	26	613.6	96.4
75.0	3.418	0.720	171.2	14.4	28	586.7	97.3
80.0	3.274	0.717	163.9	14.3	30	540.8	99.8
85.0	2.449	0.646	153.8	10.3			
90.0	2.304	0.681	128.9	12.2			
95.0	2.190	0.714	112.6	13.9			
100.0	2.060	0.817	74.2	22.7			
105.0	2.060	0.923	38.4	49.5			
110.0	2.206	0.958	22.3	94.8			
115.0	2.006	0.987	5.1	388.5			
120.0	1.571	0.995	2.0	781.6			
125.0	2.411	0.999	1.1	2189.5			

x = 900mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		x = 900mm, y = 25mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.141	0.030	71.3	1.3	5.0	2.777	0.052	109.5	1.3
9.0	3.049	0.052	98.0	1.6	9.0	2.934	0.074	126.9	1.7
12.0	3.206	0.093	111.8	2.7	12.0	3.141	0.122	149.3	2.6
14.0	3.494	0.200	137.4	5.1	15.0	3.344	0.161	164.7	3.3
16.0	3.456	0.194	153.2	4.4	18.0	3.380	0.261	203.3	4.3
18.0	3.534	0.296	167.3	6.2	21.0	3.418	0.291	208.2	4.8
20.0	3.575	0.365	169.9	7.7	24.0	3.534	0.396	227.3	6.2
22.0	3.575	0.426	187.1	8.1	27.0	3.534	0.497	214.7	8.2
24.0	3.616	0.489	167.8	10.5	30.0	3.575	0.520	219.1	8.5
26.0	3.616	0.569	179.1	11.5	33.0	3.534	0.618	204.2	10.7
28.0	3.659	0.584	172.5	12.4	36.0	3.575	0.616	216.1	10.2
30.0	3.659	0.700	171.9	14.9	39.0	3.616	0.670	190.1	12.7
32.0	3.616	0.759	152.9	18.0	42.0	3.659	0.694	171.4	14.8
34.0	3.616	0.721	171.0	15.3	45.0	3.659	0.747	167.2	16.4

36.0	3.616	0.763	156.1	17.7
40.0	3.616	0.836	128.4	23.5
45.0	3.659	0.858	116.3	27.0
50.0	3.659	0.894	95.7	34.2
55.0	3.659	0.919	75.8	44.4
60.0	3.616	0.939	61.6	55.1
70.0	3.494	0.945	49.9	66.2
80.0	3.309	0.965	37.1	86.1
95.0	3.206	0.991	13.0	244.4
110.0	2.934	0.996	6.3	463.8

50.0	3.702	0.807	134.2	22.3
55.0	3.702	0.869	104.8	30.7
60.0	3.575	0.887	97.4	32.6
65.0	3.616	0.916	80.5	41.1
70.0	3.575	0.936	64.3	52.0
75.0	3.456	0.957	51.3	64.5
80.0	3.616	0.962	37.7	92.3
90.0	3.380	0.982	21.4	155.1
100.0	3.110	0.991	10.6	290.7
115.0	3.206	0.995	4.8	664.8

x = 900mm, y = 50mm Exp. DT4 Q_w = 20.7L/s D = 35mm x = 900mm, y = 75mm

x = 900mm, y = 50mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.079	0.156	157.2	3.1
8.0	3.494	0.233	180.0	4.5
9.0	3.456	0.353	204.3	6.0
10.0	3.418	0.294	186.4	5.4
11.0	3.418	0.365	183.2	6.8
12.0	3.534	0.484	193.5	8.8
13.0	3.534	0.580	188.2	10.9
14.0	3.575	0.627	182.2	12.3
15.0	3.575	0.633	185.3	12.2
16.0	3.616	0.638	181.2	12.7
17.0	3.575	0.677	182.1	13.3
18.0	3.575	0.682	174.3	14.0
20.0	3.575	0.764	147.9	18.5
22.0	3.616	0.806	143.0	20.4
25.0	3.575	0.819	138.8	21.1
30.0	3.575	0.888	101.0	31.4
35.0	3.575	0.909	92.4	35.2
40.0	3.575	0.931	77.6	42.9
45.0	3.534	0.950	56.9	59.0
50.0	3.494	0.954	50.7	65.8
60.0	3.456	0.965	41.1	81.1
70.0	3.456	0.980	23.4	144.7
80.0	3.418	0.990	13.7	246.9
95.0	3.206	0.993	9.2	346.0
110.0	2.990	0.996	5.9	504.7

x = 900mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.344	0.214	157.9	4.5
6.0	3.380	0.204	141.0	4.9
7.0	3.418	0.232	150.3	5.3
8.0	3.575	0.429	177.4	8.6
9.0	3.534	0.477	169.4	10.0
10.0	3.575	0.566	169.8	11.9
11.0	3.575	0.640	152.4	15.0
12.0	3.616	0.686	150.7	16.5
13.0	3.575	0.713	139.4	18.3
14.0	3.616	0.778	127.0	22.2
15.0	3.616	0.841	107.8	28.2
16.0	3.659	0.859	98.6	31.9
17.0	3.702	0.862	99.1	32.2
18.0	3.659	0.874	91.9	34.8
20.0	3.702	0.912	76.9	43.9
25.0	3.659	0.947	51.0	67.9
30.0	3.534	0.969	34.5	99.3
35.0	3.534	0.982	24.0	144.5
40.0	3.418	0.987	16.2	208.3
50.0	3.240	0.987	14.8	216.0
60.0	3.173	0.988	13.8	227.3
75.0	2.321	0.993	7.3	315.7
90.0	2.907	0.994	5.7	507.0
110.0	2.175	0.996	3.0	722.1

x = 900mm, y = 100mm Exp. DT4 Q_w = 20.7L/s D = 35mm x = 900mm, y = 120mm

x = 900mm, y = 100mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.990	0.163	137.5	3.5
7.0	3.380	0.192	145.2	4.5

x = 900mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	3.049	0.015	35.4	1.3
15.0	2.853	0.029	52.9	1.6

8.0	3.309	0.258	154.1	5.5	20.0	3.344	0.155	143.6	3.6
9.0	3.380	0.345	174.0	6.7	25.0	3.309	0.316	209.0	5.0
10.0	3.534	0.457	161.9	10.0	30.0	3.344	0.462	211.9	7.3
11.0	3.494	0.573	165.9	12.1	35.0	3.418	0.574	219.8	8.9
12.0	3.575	0.599	169.0	12.7	40.0	3.418	0.629	191.8	11.2
13.0	3.575	0.691	149.8	16.5	45.0	3.418	0.660	178.9	12.6
14.0	3.575	0.754	143.1	18.8	50.0	3.418	0.704	171.0	14.1
15.0	3.534	0.855	96.5	31.3	55.0	3.274	0.729	160.4	14.9
16.0	3.575	0.839	108.8	27.6	60.0	3.274	0.749	152.3	16.1
17.0	3.494	0.891	83.2	37.4	65.0	3.240	0.754	156.8	15.6
18.0	3.534	0.855	107.7	28.1	70.0	3.141	0.763	148.4	16.2
20.0	3.575	0.888	90.0	35.3	75.0	3.049	0.717	162.7	13.4
25.0	3.240	0.948	51.4	59.8	80.0	2.777	0.725	147.1	13.7
30.0	2.990	0.961	36.2	79.4	85.0	2.728	0.662	158.1	11.4
40.0	2.592	0.962	34.3	72.7	90.0	2.449	0.650	155.1	10.3
50.0	2.488	0.968	25.5	94.4	95.0	2.304	0.622	133.0	10.8
60.0	2.374	0.965	30.1	76.1	100.0	2.321	0.632	133.7	11.0
70.0	2.287	0.955	35.6	61.3	105.0	2.175	0.757	93.4	17.6
80.0	2.304	0.936	49.2	43.8	110.0	2.254	0.848	68.0	28.1
90.0	2.270	0.933	51.3	41.3	115.0	2.206	0.918	33.6	60.3
100.0	2.304	0.934	43.3	49.7	120.0	2.304	0.967	16.4	135.8
110.0	2.254	0.958	23.4	92.2	125.0	2.237	0.983	10.5	209.4
125.0	2.237	0.995	3.4	654.8	135.0	2.006	0.997	1.5	1334.3
140.0	1.908	0.999	0.5	3813.1					

x = 1000mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.990	0.030	65.8	1.3	2	36.4	850.2
9.0	2.907	0.042	82.1	1.5	4	35.8	847.9
12.0	3.274	0.118	137.8	2.8	6	32.1	895.4
14.0	3.240	0.146	134.9	3.5	8	28.1	914.0
16.0	3.380	0.244	161.6	5.1	10	23.1	912.5
18.0	3.456	0.304	180.6	5.8	12	19.4	899.1
20.0	3.494	0.355	159.3	7.8	14	15.0	868.5
22.0	3.575	0.512	168.7	10.8	16	10.7	781.1
24.0	3.575	0.585	175.7	11.9	18	9.3	755.5
26.0	3.575	0.648	162.0	14.3	20	8.8	713.3
28.0	3.616	0.668	152.4	15.9	22	7.3	640.3
30.0	3.616	0.697	157.1	16.1			
32.0	3.616	0.738	144.0	18.5			
35.0	3.575	0.821	122.4	24.0			
40.0	3.575	0.861	109.6	28.1			
45.0	3.616	0.889	88.7	36.2			
50.0	3.616	0.894	87.4	37.0			

55.0	3.534	0.927	67.6	48.5
60.0	3.616	0.928	62.3	53.9
70.0	3.494	0.963	37.6	89.5
80.0	3.456	0.976	24.8	136.0
95.0	3.309	0.984	17.6	185.0
110.0	3.173	0.994	4.3	733.6
130.0	2.636	0.998	1.1	2392.3

x = 1000mm, y = 25mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm		x = 1000mm, y = 50mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.853	0.041	90.2	1.3	5.0	3.206	0.197	179.6	3.5
9.0	2.880	0.058	105.4	1.6	7.0	3.049	0.174	172.7	3.1
12.0	3.019	0.092	130.4	2.1	9.0	2.990	0.203	187.7	3.2
15.0	3.206	0.153	160.3	3.1	10.0	3.380	0.307	194.5	5.3
18.0	3.344	0.210	167.3	4.2	11.0	3.309	0.301	201.4	4.9
21.0	3.456	0.321	186.0	6.0	12.0	3.494	0.451	189.6	8.3
24.0	3.494	0.409	196.8	7.3	13.0	3.456	0.412	199.9	7.1
27.0	3.575	0.522	194.6	9.6	14.0	3.494	0.486	196.2	8.7
30.0	3.616	0.618	175.1	12.8	15.0	3.494	0.541	184.5	10.2
33.0	3.616	0.645	173.8	13.4	16.0	3.534	0.607	173.9	12.3
36.0	3.616	0.687	168.4	14.8	17.0	3.494	0.632	173.0	12.8
39.0	3.616	0.752	144.6	18.8	18.0	3.534	0.675	167.4	14.2
42.0	3.702	0.794	127.4	23.1	19.0	3.534	0.670	167.2	14.2
45.0	3.659	0.811	123.0	24.1	20.0	3.575	0.743	151.0	17.6
50.0	3.702	0.855	106.4	29.7	22.0	3.575	0.727	162.8	16.0
55.0	3.659	0.887	84.8	38.3	25.0	3.575	0.799	134.3	21.3
60.0	3.616	0.916	71.0	46.7	30.0	3.575	0.865	105.9	29.2
65.0	3.534	0.935	59.4	55.6	35.0	3.575	0.897	88.9	36.1
70.0	3.494	0.948	52.6	63.0	40.0	3.534	0.914	81.1	39.9
80.0	3.456	0.971	31.8	105.5	50.0	3.575	0.951	50.9	66.8
90.0	3.380	0.985	15.5	214.7	60.0	3.456	0.960	41.2	80.5
105.0	2.990	0.992	10.5	282.5	70.0	3.494	0.980	22.9	149.5
120.0	2.990	0.998	2.6	1147.3	80.0	3.309	0.983	18.3	177.7
					95.0	3.274	0.993	7.7	422.0
					110.0	3.049	0.997	2.0	1520.6

x = 1000mm, y = 75mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm		x = 1000mm, y = 100mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.534	0.498	181.7	9.7	5.0	3.240	0.199	143.3	4.5
6.0	3.380	0.367	181.9	6.8	7.0	2.777	0.162	143.6	3.1
7.0	3.494	0.376	186.5	7.0	8.0	3.049	0.181	141.6	3.9
8.0	3.456	0.444	191.1	8.0	9.0	3.141	0.243	163.3	4.7
9.0	3.380	0.522	185.2	9.5	10.0	3.380	0.357	177.8	6.8

10.0	3.494	0.596	180.0	11.6
11.0	3.534	0.669	160.8	14.7
12.0	3.575	0.695	152.4	16.3
13.0	3.494	0.737	135.0	19.1
14.0	3.534	0.838	109.7	27.0
15.0	3.575	0.844	106.3	28.4
17.0	3.659	0.904	74.2	44.6
20.0	3.534	0.935	54.4	60.8
25.0	3.534	0.957	39.8	85.0
30.0	3.456	0.966	36.1	92.5
35.0	3.418	0.973	30.9	107.6
40.0	3.344	0.979	25.3	129.4
50.0	3.309	0.987	19.6	166.5
60.0	3.173	0.980	20.5	151.7
75.0	2.962	0.985	15.5	188.2
90.0	2.962	0.988	11.3	258.9
105.0	2.827	0.995	3.9	721.3
120.0	2.356	0.997	2.2	1067.8

11.0	3.274	0.433	202.0	7.0
12.0	3.344	0.559	179.8	10.4
13.0	3.418	0.641	172.0	12.7
14.0	3.456	0.679	174.2	13.5
15.0	3.380	0.768	142.7	18.2
17.0	3.274	0.802	127.8	20.6
20.0	3.380	0.868	103.6	28.3
25.0	3.206	0.924	63.8	46.4
30.0	3.110	0.946	48.8	60.3
40.0	2.962	0.963	36.7	77.7
50.0	2.802	0.953	38.1	70.1
60.0	2.704	0.931	51.4	49.0
70.0	2.613	0.926	58.2	41.6
80.0	2.528	0.886	82.8	27.1
90.0	2.528	0.865	86.7	25.2
100.0	2.430	0.914	53.8	41.3
110.0	2.468	0.952	28.5	82.5
120.0	2.549	0.972	15.9	155.8
130.0	2.411	0.993	5.1	469.3
145.0	2.528	0.999	1.7	1485.7

x = 1000mm, y = 120mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.658	0.006	19.4	0.9	2	49.5	690.9
15.0	2.777	0.015	36.6	1.1	4	47.7	677.9
20.0	2.752	0.030	55.8	1.5	6	44.4	706.8
25.0	3.173	0.093	112.5	2.6	8	38.8	739.6
30.0	3.173	0.143	139.5	3.3	10	30.5	768.2
35.0	3.206	0.199	159.4	4.0	12	23.9	814.1
40.0	3.274	0.301	176.6	5.6	14	18.1	844.3
45.0	3.274	0.326	184.4	5.8	16	13.0	859.9
50.0	3.141	0.369	185.3	6.3	18	11.1	877.1
55.0	3.173	0.448	181.1	7.9	20	10.4	880.6
60.0	3.110	0.409	177.0	7.2	22	8.4	884.0
65.0	2.962	0.385	157.9	7.2	24	7.1	891.7
70.0	2.880	0.383	145.9	7.6	26	7.1	869.5
75.0	2.880	0.409	138.6	8.5	28	6.6	862.2
80.0	2.658	0.362	134.4	7.2	30	5.3	867.2
85.0	2.338	0.322	132.8	5.7	32	5.5	857.2
90.0	2.338	0.435	125.2	8.1	34	5.2	842.7
95.0	2.270	0.549	122.4	10.2	36	4.8	837.8
100.0	2.430	0.756	89.6	20.5	38	4.5	815.5
105.0	2.374	0.861	59.3	34.5	40	4.8	794.7
110.0	2.468	0.907	36.4	61.5	45	4.7	775.4

115.0	2.449	0.951	24.4	95.4	50	4.8	718.6
120.0	2.570	0.972	12.7	196.7	55	4.3	719.4
130.0	2.570	0.991	7.2	353.9	60	5.3	652.6
140.0	2.636	1.000	0.3	8782.9	65	5.1	625.6
					70	5.3	587.0
					75	4.5	553.5
					80	4.4	545.3
					85	3.0	501.8
					90	2.6	433.6
					95	2.5	407.3

x = 1200mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.658	0.019	49.6	1.0	2	41.6	806.2
9.0	2.880	0.030	63.8	1.4	4	39.9	826.0
12.0	2.907	0.096	136.9	2.0	6	38.9	865.9
13.0	3.141	0.128	152.8	2.6	8	32.3	878.3
14.0	3.274	0.160	162.6	3.2	10	28.0	884.9
15.0	3.380	0.251	174.8	4.9	12	20.9	844.7
16.0	3.456	0.318	203.1	5.4	14	17.1	814.8
17.0	3.494	0.423	215.8	6.9	16	13.0	678.9
18.0	3.534	0.499	214.4	8.2	18	10.5	565.2
19.0	3.534	0.584	198.3	10.4	20	7.8	433.1
20.0	3.494	0.653	187.7	12.2			
21.0	3.494	0.718	166.2	15.1			
22.0	3.494	0.769	157.6	17.1			
23.0	3.534	0.833	120.7	24.4			
24.0	3.534	0.849	114.4	26.2			
25.0	3.494	0.894	85.3	36.6			
27.0	3.494	0.921	60.7	53.0			
30.0	3.534	0.944	46.5	71.7			
35.0	3.534	0.957	39.8	84.9			
40.0	3.534	0.970	24.9	137.6			
50.0	3.418	0.985	16.5	204.0			
65.0	3.575	0.987	11.3	312.1			
80.0	3.494	0.996	4.5	773.2			

x = 1200mm, y = 25mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.704	0.016	44.6	1.0	2	26.0	790.0
9.0	2.962	0.026	59.6	1.3	4	37.6	790.6
12.0	2.990	0.047	87.6	1.6	6	36.5	827.8
14.0	2.990	0.070	118.4	1.8	8	36.2	864.2

16.0	3.173	0.120	144.6	2.6	10	31.4	872.2
17.0	3.141	0.157	167.6	2.9	12	28.1	876.2
18.0	3.380	0.224	194.4	3.9	14	21.4	840.5
19.0	3.456	0.242	198.9	4.2	16	18.3	814.1
20.0	3.494	0.342	207.6	5.8	18	14.0	713.1
21.0	3.494	0.424	209.8	7.1	20	11.3	618.4
22.0	3.494	0.465	199.4	8.1	22	9.3	516.8
23.0	3.534	0.593	205.9	10.2	24	8.4	433.1
24.0	3.534	0.606	194.5	11.0			
25.0	3.575	0.668	175.9	13.6			
26.0	3.575	0.714	160.3	15.9			
27.0	3.575	0.763	140.3	19.5			
30.0	3.659	0.855	101.6	30.8			
35.0	3.747	0.908	68.1	50.0			
40.0	3.575	0.938	51.9	64.6			
45.0	3.575	0.947	42.3	80.0			
50.0	3.616	0.962	31.3	111.1			
60.0	3.494	0.979	19.6	174.6			
75.0	3.494	0.989	9.7	356.3			
90.0	3.380	0.994	4.8	700.4			

x = 1200mm, y = 50mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.827	0.027	70.5	1.1	2	21.0	803.0
9.0	2.962	0.032	77.5	1.2	4	31.0	796.6
12.0	2.880	0.054	112.7	1.4	6	30.9	849.7
14.0	3.019	0.095	144.2	2.0	8	30.2	858.5
16.0	3.079	0.140	170.1	2.5	10	30.4	875.7
17.0	3.274	0.176	189.4	3.0	12	24.9	856.9
18.0	3.380	0.243	204.2	4.0	14	21.4	842.0
19.0	3.380	0.330	227.0	4.9	16	18.3	806.5
20.0	3.494	0.405	230.5	6.1	18	15.0	748.2
21.0	3.534	0.480	230.5	7.4	20	11.7	654.4
22.0	3.534	0.549	220.5	8.8	22	9.8	535.5
23.0	3.575	0.595	225.3	9.4			
24.0	3.575	0.675	194.9	12.4			
25.0	3.575	0.774	159.5	17.3			
26.0	3.616	0.803	141.2	20.6			
27.0	3.702	0.827	132.0	23.2			
30.0	3.659	0.880	98.0	32.9			
35.0	3.659	0.921	63.9	52.7			
40.0	3.616	0.941	48.7	69.9			
45.0	3.616	0.955	38.1	90.6			
50.0	3.659	0.960	34.4	102.1			

60.0	3.534	0.976	19.9	173.3
70.0	3.494	0.986	11.3	304.9
85.0	3.380	0.992	6.1	549.8
100.0	3.309	0.996	2.7	1221.1

x = 1200mm, y = 75mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.907	0.030	54.1	1.6	2	37.5	789.7
9.0	2.853	0.038	64.9	1.7	4	34.4	806.6
12.0	2.880	0.125	145.0	2.5	6	38.5	856.0
13.0	2.990	0.170	185.1	2.7	8	31.8	870.7
14.0	2.962	0.214	203.0	3.1	10	34.2	862.7
15.0	3.206	0.284	231.0	3.9	12	31.8	843.5
16.0	3.206	0.347	245.1	4.5	14	29.0	763.6
17.0	3.309	0.395	239.2	5.5	16	23.6	666.0
18.0	3.309	0.494	242.2	6.8	18	17.7	533.0
19.0	3.418	0.609	245.1	8.5	20	13.4	436.4
20.0	3.309	0.668	229.0	9.6			
21.0	3.494	0.680	224.1	10.6			
22.0	3.309	0.686	226.4	10.0			
23.0	3.344	0.748	179.2	14.0			
24.0	3.344	0.781	181.2	14.4			
26.0	3.274	0.844	149.5	18.5			
30.0	3.344	0.886	111.1	26.7			
35.0	3.418	0.919	78.7	39.9			
40.0	3.418	0.954	45.9	71.1			
45.0	3.309	0.958	39.9	79.4			
50.0	3.309	0.949	43.1	72.8			
60.0	3.418	0.978	17.3	193.3			
70.0	3.380	0.985	12.4	268.5			
85.0	3.049	0.986	9.4	319.8			
100.0	3.173	0.996	3.0	1053.1			

x = 1200mm, y = 100mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.658	0.012	25.3	1.3	2	49.8	698.4
9.0	2.658	0.023	41.7	1.5	4	51.1	713.7
12.0	2.802	0.038	64.8	1.6	6	53.6	767.9
15.0	2.907	0.104	129.6	2.3	8	54.1	810.9
18.0	2.962	0.205	182.3	3.3	10	50.1	815.4
21.0	2.934	0.263	212.1	3.6	12	45.1	806.9
24.0	3.049	0.438	224.7	5.9	14	41.0	784.5
27.0	3.240	0.555	220.2	8.2	16	35.7	723.2

30.0	3.110	0.670	185.9	11.2	18	32.8	689.3
33.0	3.079	0.714	153.3	14.3	20	29.5	626.4
36.0	3.079	0.803	124.1	19.9	22	23.8	539.0
39.0	2.990	0.821	128.2	19.2	24	17.4	450.8
42.0	2.853	0.855	94.8	25.7	26	16.3	422.6
45.0	2.853	0.777	118.5	18.7			
50.0	2.802	0.792	113.2	19.6			
55.0	2.853	0.840	92.5	25.9			
60.0	2.907	0.868	82.4	30.6			
65.0	2.907	0.868	74.2	34.0			
70.0	2.827	0.897	59.9	42.4			
75.0	2.802	0.933	40.8	64.0			
80.0	2.827	0.924	41.7	62.7			
90.0	3.079	0.972	17.4	172.0			
105.0	2.528	0.994	4.1	612.9			
120.0	2.934	0.998	1.7	1722.2			

x = 1200mm, y = 120mm		Exp. DT4		Q_w = 20.7L/s	D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.613	0.006	16.8	1.0	2	56.5	698.0
20.0	2.728	0.010	24.0	1.2	4	53.2	701.5
25.0	2.528	0.010	19.7	1.2	6	51.3	724.9
30.0	2.321	0.024	34.2	1.7	8	51.5	744.8
35.0	2.392	0.064	59.3	2.6	10	50.7	776.8
39.0	2.430	0.147	101.8	3.5	12	50.9	798.8
42.0	2.430	0.203	109.1	4.5	14	50.7	799.6
45.0	2.636	0.308	118.5	6.9	16	49.4	815.3
48.0	2.704	0.363	127.2	7.7	18	47.4	809.6
51.0	2.752	0.449	135.4	9.1	20	46.2	789.1
54.0	2.802	0.546	122.8	12.4	22	46.3	790.1
57.0	2.802	0.529	126.8	11.7	24	40.3	763.2
60.0	2.802	0.644	116.8	15.5	26	36.4	719.7
63.0	2.880	0.722	106.0	19.6	28	33.2	676.7
66.0	2.907	0.776	86.7	26.0	30	28.1	644.4
69.0	2.880	0.833	68.6	35.0	32	23.8	609.1
72.0	2.827	0.858	67.6	35.9	34	20.1	623.5
75.0	3.019	0.905	45.8	59.6	36	16.5	592.0
80.0	2.853	0.936	34.2	78.1	38	13.9	554.8
85.0	2.990	0.940	30.3	92.8	40	9.4	512.6
90.0	2.907	0.969	14.7	191.5	42	7.9	519.3
100.0	3.141	0.987	7.7	402.8	44	7.1	525.7
115.0	3.049	0.998	1.8	1689.7	46	6.0	424.8
					48	5.3	446.6
					50	4.7	453.1

					52	4.8	412.2
					54	4.9	362.5

x = 1400mm, y = 0mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.853	0.013	22.1	1.6	2	34.8	769.0
10.0	2.990	0.040	52.9	2.2	4	32.6	780.7
12.0	2.962	0.107	110.4	2.9	6	30.9	849.8
13.0	3.380	0.169	135.0	4.2	8	27.2	867.1
14.0	3.344	0.235	179.2	4.4	10	21.9	854.3
15.0	3.494	0.332	212.1	5.5	12	16.8	806.1
16.0	3.494	0.465	241.7	6.7	14	12.3	693.9
17.0	3.494	0.540	231.8	8.1	16	9.7	548.3
18.0	3.494	0.643	205.8	10.9	18	7.7	414.7
19.0	3.534	0.741	186.3	14.1			
20.0	3.456	0.810	166.9	16.8			
21.0	3.534	0.851	135.1	22.3			
22.0	3.575	0.903	107.1	30.2			
23.0	3.575	0.929	81.6	40.7			
24.0	3.534	0.950	61.3	54.8			
25.0	3.534	0.960	49.4	68.7			
26.0	3.534	0.968	41.7	82.0			
28.0	3.534	0.982	28.1	123.6			
30.0	3.702	0.988	14.4	254.0			
35.0	3.840	0.992	9.8	388.8			
40.0	3.659	0.997	3.0	1215.6			
50.0	3.888	0.998	2.5	1551.1			

x = 1400mm, y = 25mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	3.309	0.011	22.7	1.6	2	37.9	760.8
10.0	3.049	0.037	55.8	2.0	4	33.5	769.6
12.0	3.173	0.077	87.9	2.8	6	34.6	833.9
13.0	3.206	0.110	117.5	3.0	8	30.6	873.6
14.0	3.344	0.179	158.1	3.8	10	25.3	864.8
15.0	3.494	0.272	197.3	4.8	12	19.0	828.9
16.0	3.494	0.347	209.8	5.8	14	14.3	756.6
17.0	3.534	0.409	232.8	6.2	16	11.1	633.8
18.0	3.494	0.538	239.0	7.9	18	8.8	512.8
19.0	3.534	0.649	217.0	10.6			
20.0	3.534	0.723	204.9	12.5			
21.0	3.494	0.771	183.2	14.7			
22.0	3.534	0.830	160.7	18.2			

23.0	3.534	0.870	125.0	24.6
24.0	3.494	0.904	104.3	30.3
25.0	3.575	0.931	84.8	39.2
26.0	3.494	0.930	90.6	35.9
28.0	3.456	0.962	49.5	67.1
30.0	3.240	0.961	47.0	66.2
35.0	3.240	0.971	29.7	105.9
40.0	3.344	0.979	27.0	121.3
50.0	3.418	0.991	7.9	428.8
60.0	3.240	0.996	5.1	632.9

x = 1400mm, y = 50mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.853	0.008	18.9	1.2	2	41.5	735.6
10.0	2.704	0.015	30.5	1.3	4	38.0	751.5
12.0	2.853	0.038	61.9	1.7	6	37.7	810.1
13.0	2.907	0.061	91.7	1.9	8	36.9	846.2
14.0	2.990	0.084	110.7	2.3	10	31.9	862.4
15.0	3.173	0.094	129.9	2.3	12	27.0	859.4
16.0	3.274	0.155	155.7	3.3	14	20.5	825.8
17.0	3.309	0.195	186.4	3.5	16	15.2	755.8
18.0	3.380	0.266	213.7	4.2	18	12.3	675.8
19.0	3.274	0.359	250.9	4.7	20	10.2	598.0
20.0	3.380	0.424	262.1	5.5	22	8.3	530.6
21.0	3.380	0.501	278.5	6.1			
22.0	3.274	0.548	267.0	6.7			
24.0	3.309	0.617	285.3	7.2			
27.0	3.240	0.682	264.1	8.4			
30.0	3.206	0.782	215.9	11.6			
33.0	3.173	0.792	203.1	12.4			
36.0	3.173	0.830	166.6	15.8			
40.0	3.110	0.851	143.2	18.5			
45.0	3.110	0.894	103.1	27.0			
50.0	3.079	0.936	66.0	43.7			
55.0	3.141	0.970	35.6	85.6			
60.0	3.019	0.984	17.6	168.9			
70.0	3.110	0.996	6.1	507.7			

x = 1400mm, y = 75mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.728	0.010	22.5	1.2	2	25.5	678.0
9.0	2.752	0.012	25.9	1.2	4	21.2	680.0
12.0	2.827	0.027	51.8	1.5	6	40.2	755.3

15.0	2.880	0.050	83.5	1.7	8	34.8	792.8
18.0	2.880	0.083	122.8	2.0	10	36.7	819.3
21.0	2.880	0.121	160.7	2.2	12	34.0	821.1
24.0	3.019	0.195	204.9	2.9	14	27.3	824.5
27.0	2.962	0.232	225.2	3.1	16	22.7	813.7
30.0	3.019	0.291	244.9	3.6	18	18.2	794.5
32.0	3.049	0.324	241.1	4.1	20	14.7	752.9
34.0	3.019	0.371	239.8	4.7	22	11.5	725.0
36.0	3.049	0.444	231.6	5.9	24	8.6	681.6
38.0	3.079	0.519	214.8	7.4	26	7.0	669.6
40.0	3.049	0.606	198.4	9.3	28	5.2	620.4
42.0	3.019	0.682	177.7	11.6	30	3.4	624.5
44.0	3.049	0.734	162.8	13.8	32	2.5	585.9
46.0	3.079	0.821	126.2	20.0	34	1.7	564.3
48.0	3.079	0.866	100.4	26.6	36	1.2	516.5
50.0	3.019	0.892	85.3	31.6	38	1.0	492.5
52.0	3.079	0.926	65.6	43.5			
54.0	3.079	0.946	51.3	56.8			
57.0	3.110	0.964	36.1	83.0			
62.0	3.079	0.985	17.2	176.3			
70.0	3.309	0.997	4.4	749.3			

x = 1400mm, y = 100mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.338	0.002	6.2	0.8	2	27.6	601.3
10.0	2.658	0.005	11.5	1.1	4	25.1	595.6
15.0	2.681	0.011	23.7	1.2	6	23.1	636.5
20.0	2.704	0.019	39.4	1.3	8	23.0	678.2
23.0	2.681	0.035	54.3	1.7	10	21.8	708.1
26.0	2.728	0.074	78.7	2.5	12	20.2	727.7
28.0	2.777	0.141	105.3	3.7	14	19.0	742.3
30.0	2.907	0.261	132.5	5.7	16	16.9	753.3
32.0	2.880	0.392	142.2	7.9	18	16.4	772.4
34.0	2.962	0.536	143.2	11.1	20	15.3	769.7
36.0	2.990	0.651	136.7	14.2	22	13.6	744.0
38.0	3.019	0.758	111.9	20.5	24	12.7	732.7
40.0	3.019	0.832	99.3	25.3	26	11.8	717.4
42.0	3.110	0.897	62.6	44.6	28	9.6	665.1
44.0	3.110	0.936	46.4	62.7	30	8.7	629.2
47.0	3.049	0.943	39.1	73.5	32	7.2	558.3
50.0	3.173	0.982	14.2	219.4			
55.0	3.206	0.986	11.7	270.2			
60.0	3.240	0.995	4.4	732.8			
70.0	4.319	0.998	1.0	4312.1			

x = 1400mm, y = 120mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	1.220	0.003	7.5	0.5	2	29.5	610.9
10.0	1.932	0.006	13.0	1.0	4	26.4	629.9
15.0	2.160	0.018	30.1	1.3	6	24.2	639.2
18.0	2.237	0.050	56.0	2.0	8	23.0	640.8
20.0	2.304	0.068	79.2	2.0	10	20.3	615.9
22.0	2.430	0.110	104.5	2.5	12	17.2	583.5
24.0	2.528	0.162	117.3	3.5	14	16.5	572.7
26.0	2.528	0.284	162.2	4.4	16	15.7	546.6
28.0	2.570	0.415	189.6	5.6	18	21.9	555.6
30.0	2.570	0.541	198.2	7.0	20	18.2	533.3
32.0	2.468	0.714	165.6	10.6	22	16.7	523.1
34.0	2.592	0.772	160.3	12.5	24	14.0	508.9
36.0	2.681	0.890	104.2	22.9	26	11.2	493.5
38.0	2.658	0.934	64.6	38.4	28	9.2	453.7
40.0	2.613	0.966	42.9	58.9	30	7.1	390.1
42.0	2.752	0.978	23.7	113.5			
45.0	2.636	0.988	14.3	182.0			
50.0	4.859	0.997	5.4	897.1			
60.0	4.859	0.999	1.0	4855.4			

x = 1600mm, y = 0mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.880	0.008	12.2	1.9	2	25.4	693.2
10.0	2.853	0.021	27.8	2.1	4	22.7	673.6
12.0	2.962	0.051	61.2	2.5	6	23.2	755.5
14.0	2.907	0.099	105.7	2.7	8	23.6	800.3
16.0	3.019	0.230	183.9	3.8	10	27.4	818.6
18.0	3.110	0.339	269.1	3.9	12	26.1	816.8
20.0	3.206	0.500	287.9	5.6	14	24.6	792.7
22.0	3.141	0.517	314.8	5.2	16	23.1	717.2
24.0	3.380	0.584	308.5	6.4	18	18.9	642.6
26.0	3.309	0.599	317.8	6.2	20	18.2	583.6
28.0	3.344	0.632	290.4	7.3	22	17.5	513.3
30.0	3.344	0.620	284.2	7.3			
32.0	3.380	0.657	269.9	8.2			
34.0	3.344	0.656	264.3	8.3			
36.0	3.344	0.705	225.0	10.5			
38.0	3.344	0.733	211.1	11.6			
40.0	3.380	0.778	190.8	13.8			
42.0	3.380	0.840	148.4	19.1			
44.0	3.344	0.874	109.6	26.7			

47.0	3.380	0.913	85.3	36.2
50.0	3.274	0.952	55.6	56.0
55.0	3.344	0.975	25.0	130.4
60.0	3.456	0.989	10.8	316.4
70.0	3.309	0.998	2.9	1138.2

x = 1600mm, y = 25mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.752	0.015	22.6	1.8	2	26.6	690.6
10.0	2.752	0.033	42.3	2.2	4	26.1	694.2
12.0	2.934	0.084	99.2	2.5	6	34.4	752.9
14.0	2.934	0.168	157.9	3.1	8	31.4	801.1
16.0	2.962	0.287	225.3	3.8	10	30.8	834.9
18.0	3.110	0.391	263.9	4.6	12	25.5	801.2
20.0	3.110	0.482	304.5	4.9	14	22.7	766.8
22.0	3.079	0.548	314.0	5.4	16	20.7	702.9
24.0	3.141	0.625	282.4	7.0	18	17.2	620.9
26.0	3.141	0.683	266.7	8.0	20	16.0	574.2
28.0	3.206	0.741	229.9	10.3	22	13.8	488.3
30.0	3.173	0.764	213.0	11.4			
32.0	3.206	0.831	163.1	16.3			
34.0	3.240	0.844	152.4	17.9			
36.0	3.240	0.867	132.8	21.2			
38.0	3.274	0.890	105.1	27.7			
40.0	3.240	0.903	99.1	29.5			
43.0	3.240	0.937	64.0	47.4			
46.0	3.240	0.947	50.0	61.4			
50.0	3.274	0.972	25.5	124.8			
55.0	3.309	0.981	18.0	180.3			
60.0	3.274	0.988	10.4	311.1			
70.0	3.309	0.996	5.0	659.0			
80.0	1.681	1.000	0.5	3361.6			

x = 1600mm, y = 50mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.752	0.010	18.9	1.4	2	28.0	676.3
10.0	2.880	0.023	41.8	1.6	4	25.2	668.9
13.0	2.853	0.045	70.4	1.8	6	27.3	731.0
16.0	2.827	0.080	108.7	2.1	8	32.1	770.1
18.0	2.907	0.130	157.0	2.4	10	31.3	800.4
20.0	2.990	0.213	200.3	3.2	12	26.8	815.0
22.0	2.934	0.237	204.6	3.4	14	23.4	814.4
24.0	3.019	0.318	243.5	3.9	16	20.6	779.2

26.0	3.079	0.373	227.3	5.1	18	18.6	757.6
28.0	3.110	0.485	217.1	6.9	20	16.4	720.3
30.0	3.110	0.538	217.0	7.7	22	14.0	690.3
32.0	3.141	0.625	183.7	10.7	24	11.7	610.3
34.0	3.141	0.675	160.3	13.2	26	10.0	582.4
36.0	3.173	0.719	147.1	15.5	28	8.7	538.5
38.0	3.206	0.805	107.0	24.1	30	7.8	510.0
40.0	3.240	0.852	90.6	30.5			
42.0	3.206	0.892	62.3	45.9			
44.0	3.206	0.923	43.9	67.4			
47.0	3.206	0.943	36.4	83.0			
50.0	3.240	0.967	22.3	140.4			
55.0	3.240	0.981	14.1	225.5			
60.0	3.240	0.991	8.3	386.9			
70.0	3.141	0.995	3.7	844.5			
80.0	3.309	0.999	1.0	3304.9			

x = 1600mm, y = 75mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.704	0.003	8.2	1.1	2	24.0	617.0
10.0	2.704	0.008	16.5	1.3	4	21.9	604.2
15.0	2.802	0.017	35.3	1.3	6	20.7	662.7
20.0	2.752	0.047	66.8	1.9	8	19.4	711.6
22.0	2.752	0.065	90.7	2.0	10	19.6	747.2
24.0	2.777	0.101	105.6	2.6	12	23.9	766.7
26.0	2.907	0.164	118.6	4.0	14	20.7	783.9
28.0	2.907	0.265	150.0	5.1	16	21.1	789.0
30.0	3.049	0.378	146.5	7.9	18	19.3	788.9
32.0	3.141	0.537	132.0	12.8	20	17.2	786.7
34.0	3.141	0.593	120.7	15.4	22	16.1	786.4
36.0	3.141	0.733	89.8	25.6	24	13.9	763.3
38.0	3.173	0.819	72.3	36.0	26	12.0	737.4
40.0	3.173	0.874	47.5	58.4	28	10.3	694.2
42.0	3.173	0.889	47.9	58.9	30	8.3	631.5
44.0	3.240	0.935	30.7	98.7	32	7.4	556.1
46.0	3.240	0.956	21.5	144.0			
50.0	3.240	0.979	9.8	323.6			
55.0	3.274	0.983	10.3	312.4			
60.0	3.240	0.994	3.8	847.2			
65.0	3.274	0.998	1.6	2042.9			

x = 1600mm, y = 100mm		Exp. DT4		Q_w = 20.7L/s	D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.528	0.007	15.0	1.3	2	22.6	593.1
15.0	2.508	0.020	27.6	1.8	4	20.5	581.7
18.0	2.528	0.042	47.0	2.3	6	18.8	628.9
20.0	2.658	0.058	52.0	3.0	8	18.1	653.6
21.0	2.853	0.099	69.0	4.1	10	17.3	681.5
22.0	2.777	0.112	74.8	4.1	12	14.8	699.1
23.0	2.853	0.176	94.8	5.3	14	14.6	716.3
24.0	2.907	0.182	93.9	5.6	16	21.9	725.0
25.0	2.990	0.313	116.9	8.0	18	22.6	731.1
26.0	2.990	0.332	125.1	7.9	20	19.6	723.0
27.0	3.049	0.427	122.1	10.7	22	17.7	717.7
28.0	3.079	0.556	115.7	14.8	24	15.1	682.5
29.0	3.110	0.619	110.3	17.4	26	11.8	623.4
30.0	3.110	0.707	99.8	22.0	28	9.1	551.5
31.0	3.110	0.769	72.0	33.2			
32.0	3.141	0.826	70.3	36.9			
33.0	3.141	0.841	60.7	43.5			
34.0	3.141	0.874	49.8	55.2			
35.0	3.173	0.924	36.7	79.9			
36.0	3.206	0.935	30.9	97.0			
38.0	3.240	0.968	17.7	177.2			
41.0	3.240	0.986	7.3	437.4			
46.0	3.344	0.999	1.2	2784.1			

x = 1600mm, y = 120mm		Exp. DT4		Q_w = 20.7L/s	D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.060	0.010	15.1	1.3	2	22.7	495.9
15.0	2.206	0.037	44.0	1.9	4	20.4	506.4
18.0	2.237	0.075	75.2	2.2	6	18.7	541.4
20.0	2.270	0.133	100.2	3.0	8	16.3	524.4
21.0	2.270	0.171	115.9	3.3	10	15.2	526.4
22.0	2.338	0.221	137.8	3.7	12	15.5	506.5
23.0	2.304	0.321	153.9	4.8	14	26.7	504.9
24.0	2.356	0.354	160.7	5.2	16	24.4	502.4
25.0	2.374	0.443	154.9	6.8	18	21.9	501.0
26.0	2.468	0.526	160.5	8.1	20	19.0	482.7
27.0	2.430	0.544	174.1	7.6	22	15.1	471.8
28.0	2.488	0.667	148.4	11.2	24	11.2	441.4
29.0	2.488	0.717	146.0	12.2	26	7.9	390.1
30.0	2.528	0.763	122.0	15.8			
31.0	2.592	0.852	93.2	23.7			

32.0	2.570	0.850	92.7	23.6
33.0	2.636	0.887	69.4	33.7
34.0	2.658	0.929	48.0	51.4
35.0	2.752	0.939	44.0	58.7
36.0	2.728	0.952	32.2	80.7
38.0	2.728	0.975	17.7	150.2
41.0	3.141	0.994	5.2	600.3
46.0	2.681	0.999	0.8	3349.6

x = 1800mm, y = 0mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.728	0.009	15.6	1.5	2	30.6	637.0
15.0	2.802	0.035	59.5	1.6	4	27.1	630.2
18.0	2.827	0.049	83.2	1.7	6	26.2	687.2
21.0	2.827	0.081	118.5	1.9	8	26.5	740.0
24.0	2.934	0.116	167.8	2.0	10	24.5	768.4
27.0	2.962	0.183	220.0	2.5	12	22.8	792.5
30.0	3.079	0.213	234.1	2.8	14	21.2	793.7
33.0	3.141	0.292	269.2	3.4	16	19.0	798.6
36.0	3.206	0.373	281.3	4.3	18	15.8	806.8
38.0	3.206	0.447	269.2	5.3	20	14.8	788.0
40.0	3.274	0.612	240.5	8.3	22	19.5	777.8
42.0	3.309	0.706	208.4	11.2	24	22.6	766.6
44.0	3.309	0.752	188.7	13.2	26	20.1	737.1
46.0	3.309	0.877	118.7	24.5	28	18.8	743.5
48.0	3.344	0.914	91.9	33.3	30	15.7	709.7
50.0	3.274	0.957	49.2	63.7	32	13.2	686.7
52.0	3.380	0.976	30.7	107.5	34	11.0	678.7
54.0	3.274	0.977	28.1	113.9	36	8.9	606.5
56.0	3.240	0.991	11.8	272.0	38	7.9	549.9
60.0	3.309	0.995	7.0	470.4	40	6.6	493.6
65.0	3.344	0.999	2.5	1335.8			

x = 1800mm, y = 25mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
5.0	2.704	0.004	9.2	1.2	2	28.7	662.0
10.0	2.728	0.013	26.4	1.4	4	26.5	659.1
15.0	2.853	0.057	92.9	1.8	6	26.3	713.5
18.0	2.880	0.089	135.0	1.9	8	25.4	755.6
20.0	2.880	0.137	191.4	2.1	10	24.4	791.9
22.0	2.907	0.206	256.5	2.3	12	22.4	801.9
24.0	2.962	0.230	277.9	2.4	14	19.7	810.9
26.0	3.049	0.325	328.5	3.0	16	16.0	791.4

28.0	3.079	0.367	333.9	3.4	18	15.1	776.4
30.0	3.141	0.459	362.7	4.0	20	14.1	763.8
32.0	3.240	0.536	360.5	4.8	22	13.1	731.9
34.0	3.240	0.567	364.6	5.0	24	12.6	697.7
36.0	3.309	0.666	310.3	7.1	26	12.7	659.2
38.0	3.344	0.704	304.2	7.7	28	11.7	627.7
40.0	3.344	0.748	274.2	9.1	30	11.8	585.6
42.0	3.380	0.820	213.9	13.0	32	10.9	560.3
44.0	3.309	0.873	157.1	18.4			
46.0	3.344	0.928	102.3	30.3			
48.0	3.274	0.931	96.0	31.8			
50.0	3.380	0.966	53.0	61.6			
52.0	3.344	0.975	42.4	76.9			
55.0	3.344	0.980	30.5	107.5			
60.0	3.240	0.995	10.0	322.4			
65.0	3.380	0.998	2.6	1297.6			

x = 1800mm, y = 50mm			Exp. DT4	Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.752	0.007	13.1	1.4	2	26.9	645.7
15.0	2.827	0.024	43.7	1.6	4	24.7	649.2
18.0	2.777	0.041	63.7	1.8	6	24.0	700.4
20.0	2.752	0.067	94.6	1.9	8	23.4	739.5
22.0	2.934	0.163	161.1	3.0	10	23.6	770.9
23.0	3.019	0.182	169.1	3.3	12	21.9	779.5
24.0	3.110	0.264	201.6	4.1	14	21.7	799.9
25.0	3.079	0.350	232.0	4.7	16	21.1	806.6
26.0	3.141	0.418	245.5	5.4	18	18.7	794.0
27.0	3.141	0.490	245.1	6.3	20	15.5	775.6
28.0	3.141	0.534	243.9	6.9	22	14.3	757.4
29.0	3.206	0.689	229.7	9.6	24	13.1	715.6
30.0	3.173	0.732	199.0	11.7	26	11.3	633.7
31.0	3.240	0.773	192.0	13.0	28	9.9	553.8
32.0	3.309	0.825	158.0	17.3	30	8.8	448.1
33.0	3.274	0.854	151.7	18.4			
34.0	3.240	0.894	112.1	25.8			
36.0	3.274	0.924	87.9	34.4			
40.0	3.344	0.963	51.1	63.1			
45.0	3.456	0.990	16.5	207.4			
50.0	3.494	0.993	8.4	413.2			
55.0	2.962	0.999	2.2	1344.8			

x = 1800mm, y = 75mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.570	0.001	3.7	0.9	2	24.1	590.4
15.0	2.592	0.008	14.0	1.5	4	21.4	594.4
20.0	2.752	0.038	44.6	2.4	6	21.5	645.4
22.0	2.880	0.099	77.7	3.7	8	19.9	680.9
23.0	3.049	0.164	104.9	4.8	10	19.3	711.2
24.0	3.110	0.238	128.8	5.7	12	18.0	727.3
25.0	3.206	0.338	142.0	7.6	14	22.0	755.1
26.0	3.141	0.441	150.0	9.2	16	24.9	752.1
27.0	3.141	0.567	144.5	12.3	18	24.3	761.3
28.0	3.173	0.696	137.0	16.1	20	21.6	767.8
29.0	3.240	0.758	111.5	22.0	22	17.1	753.7
30.0	3.206	0.861	90.0	30.7	24	13.7	705.9
31.0	3.274	0.894	65.7	44.5	26	10.4	582.1
32.0	3.240	0.937	42.8	71.0	28	8.5	481.0
33.0	3.206	0.955	37.6	81.4	30	7.0	353.1
34.0	3.240	0.967	25.8	121.4			
35.0	3.344	0.985	15.0	219.7			
37.0	3.344	0.993	8.5	390.6			
40.0	3.659	0.996	3.7	985.0			
45.0	3.575	0.998	2.1	1699.2			

x = 1800mm, y = 100mm		Exp. DT4		Q_w = 20.7L/s		D = 35mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.613	0.004	7.4	1.3	2	24.1	578.3
15.0	2.704	0.010	16.5	1.7	4	22.0	562.9
17.0	2.636	0.023	22.5	2.7	6	20.9	604.8
19.0	2.658	0.061	46.9	3.5	8	20.6	646.0
20.0	2.592	0.065	48.1	3.5	10	19.1	661.8
21.0	2.704	0.112	65.0	4.6	12	24.5	680.8
22.0	2.962	0.193	95.8	6.0	14	27.6	699.8
23.0	3.049	0.263	117.2	6.8	16	28.1	711.3
24.0	3.019	0.404	115.6	10.6	18	26.2	719.0
25.0	3.110	0.522	123.7	13.1	20	22.5	717.8
26.0	3.079	0.648	126.7	15.8	22	16.9	670.9
27.0	3.110	0.737	110.3	20.8	24	13.0	605.0
28.0	3.141	0.805	92.9	27.2	26	9.4	500.3
29.0	3.173	0.854	82.8	32.7	28	7.9	421.3
30.0	3.173	0.896	64.2	44.3	30	6.1	279.9
31.0	3.240	0.937	43.3	70.1			
32.0	3.274	0.964	25.6	123.3			
34.0	3.240	0.989	9.5	337.2			

36.0	3.274	0.998	3.3	990.0
40.0	5.016	1.000	0.2	25078.2

x = 1800mm, y = 120mm		Exp. DT4	Q_w = 20.7L/s		D = 35mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
10.0	2.033	0.009	13.4	1.3	2	24.4	477.2
15.0	1.968	0.027	33.2	1.6	4	21.8	478.1
17.0	2.019	0.031	38.2	1.7	6	21.2	523.7
19.0	2.060	0.041	50.2	1.7	8	18.7	529.3
20.0	2.060	0.050	56.8	1.8	10	19.4	534.9
21.0	2.046	0.079	77.2	2.1	12	29.8	540.5
22.0	2.145	0.138	98.3	3.0	14	30.1	539.9
23.0	2.046	0.155	117.8	2.7	16	30.0	532.1
24.0	2.160	0.235	139.7	3.6	18	28.7	550.1
25.0	2.046	0.251	149.9	3.4	20	24.0	537.6
26.0	2.206	0.338	159.8	4.7	22	18.4	524.5
27.0	2.190	0.413	172.4	5.3	24	13.2	501.8
28.0	2.221	0.519	173.7	6.6	26	9.8	472.2
29.0	2.270	0.523	184.6	6.4	28	8.0	422.5
30.0	2.206	0.616	175.5	7.7	30	7.1	381.6
31.0	2.356	0.715	147.9	11.4			
32.0	2.338	0.826	112.6	17.1			
33.0	2.430	0.844	99.6	20.6			
34.0	2.488	0.887	83.9	26.3			
35.0	2.430	0.919	59.6	37.5			
36.0	2.508	0.953	37.2	64.3			
38.0	2.468	0.946	45.7	51.1			
40.0	2.411	0.990	11.5	207.5			
44.0	3.747	0.999	1.0	3743.8			

Table I-7 Double-tip conductivity probe data: Experiment DT5

x = -150mm, y = 0mm			Exp. DT5	Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
37.0	2.570	0.036	5.5	16.9	2	34.8	677.6
37.5	2.411	0.063	4.1	36.9	4	30.1	674.0
38.0	2.549	0.156	11.3	35.2	6	29.1	820.4
38.5	2.356	0.136	12.9	24.9	8	28.8	893.6
39.0	5.016	0.392	14.3	137.5	10	26.5	933.6
39.5	2.636	0.408	18.9	57.0	12	24.4	946.9
40.0	3.456	0.664	17.2	133.5	14	19.3	952.7
40.5	2.430	0.593	20.5	70.3	16	17.8	951.8
41.0	2.880	0.815	12.1	194.1	18	14.8	954.2
41.5	2.130	0.907	8.4	230.1	20	13.5	953.1
42.0	3.309	0.923	7.5	407.2	22	11.4	953.1
42.5	3.888	0.961	6.8	549.1	24	9.1	952.3
43.0	5.016	0.997	0.6	8338.2	26	7.0	953.8
					28	5.9	953.1
					30	29.2	953.8
					32	28.9	954.7
					34	23.5	953.2
					36	22.5	952.6
					38	15.4	932.7
					40	11.2	905.9
					42	4.1	478.7
					44	3.2	217.6

x = -150mm, y = 25mm			Exp. DT5	Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
32.0	1.851	0.018	1.3	25.8	2	37.0	852.1
33.0	1.296	0.051	5.2	12.7	4	33.3	857.7
34.0	2.130	0.162	10.7	32.3	6	29.8	941.8
34.5	2.006	0.075	9.5	15.9	8	28.1	945.7
35.0	2.880	0.210	20.6	29.4	10	25.6	955.6
35.5	3.534	0.241	19.7	43.2	12	21.8	955.2
36.0	3.049	0.441	30.2	44.5	14	20.0	954.0
36.5	2.392	0.633	22.1	68.5	16	17.3	954.4
37.0	3.534	0.641	33.6	67.4	18	14.1	954.9
37.5	3.793	0.885	15.1	222.2	20	11.1	955.1
38.0	4.319	0.912	10.4	378.7	22	8.3	955.2
39.0	3.659	0.969	3.5	1013.2	24	6.1	955.3
40.0	4.642	0.997	1.7	2722.1	26	4.9	960.1
					28	4.4	955.3
					30	31.0	953.4

					32	25.6	953.5
					34	23.4	938.8
					36	15.8	858.0
					38	7.9	646.0
					40	4.4	229.3
					42	4.2	201.8
					44	4.1	202.8

x = -150mm, y = 50mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
36.0	1.427	0.019	3.5	7.8	2	35.6	904.4
36.5	2.356	0.087	14.1	14.6	4	33.2	894.4
37.0	2.528	0.101	17.9	14.3	6	29.8	951.7
37.5	3.987	0.255	40.4	25.1	8	27.6	952.5
38.0	2.728	0.386	50.7	20.8	10	25.7	954.6
38.5	3.240	0.673	46.2	47.2	12	22.8	953.5
39.0	4.507	0.794	33.6	106.5	14	20.7	956.6
39.5	4.260	0.931	17.8	222.8	16	18.4	956.3
40.0	4.039	0.933	11.3	333.6	18	15.4	955.8
40.5	3.702	0.984	5.6	650.3	20	13.4	955.6
					22	11.1	955.4
					24	9.2	955.5
					26	7.7	955.7
					28	6.9	955.3
					30	6.8	954.0
					32	27.6	955.4
					34	22.7	955.4
					36	13.7	951.7
					38	7.8	894.5
					40	4.5	416.2
					42	3.1	207.3
					44	3.9	201.8

x = -150mm, y = 75mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
39.0	2.087	0.045	22.0	4.3	2	32.2	811.9
39.5	2.237	0.100	36.2	6.2	4	29.1	860.1
40.0	2.549	0.160	51.4	7.9	6	28.6	905.0
40.5	2.613	0.312	63.7	12.8	8	27.4	944.4
41.0	2.508	0.579	72.6	20.0	10	26.1	941.0
41.5	3.240	0.683	73.7	30.0	12	23.8	952.9
42.0	3.049	0.661	69.0	29.2	14	21.5	956.2
42.5	3.534	0.929	26.8	122.5	16	19.0	956.5

43.0	3.840	0.938	23.3	154.6	18	17.1	956.6
43.5	3.240	0.969	13.8	227.6	20	14.8	956.5
44.0	2.962	0.982	9.1	319.8	22	12.4	956.4
					24	10.4	956.4
					26	9.0	956.0
					28	7.9	956.1
					30	7.9	954.6
					32	7.7	954.6
					34	33.0	954.6
					36	24.8	947.7
					38	15.6	928.2
					40	6.7	791.5
					42	5.1	356.1
					44	4.7	206.8

x = -150mm, y = 100mm		Exp. DT5		Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
38.0	2.752	0.022	41.3	1.5	2	41.1	690.4
39.0	2.802	0.060	92.8	1.8	4	36.8	665.1
40.0	3.206	0.156	162.5	3.1	6	36.4	767.7
41.0	3.206	0.281	215.5	4.2	8	35.3	849.8
41.5	3.240	0.450	206.6	7.1	10	33.4	906.1
42.0	3.344	0.628	176.3	11.9	12	31.0	938.5
42.5	3.380	0.669	151.3	14.9	14	28.3	949.5
43.0	3.418	0.794	107.7	25.2	16	26.1	953.1
43.5	3.456	0.799	111.8	24.7	18	23.4	955.6
44.0	3.456	0.838	91.8	31.6	20	20.8	955.9
45.0	3.456	0.950	33.2	98.9	22	17.9	954.9
46.0	3.494	0.972	20.6	164.9	24	14.9	956.1
47.0	3.456	0.994	3.8	904.3	26	13.2	957.2
					28	10.4	953.6
					30	9.7	949.0
					32	8.2	947.8
					34	7.1	946.0
					36	7.5	933.0
					38	25.9	920.6
					40	19.4	890.1
					42	9.0	792.9
					44	5.4	724.6

x = -150mm, y = 115mm		Exp. DT5		Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
35.0	2.681	0.008	16.4	1.2	2	37.2	650.9

36.0	2.221	0.007	13.9	1.2	4	38.7	625.8
37.0	2.287	0.017	24.8	1.6	6	35.7	712.7
38.0	2.752	0.140	70.2	5.5	8	34.9	782.0
39.0	2.728	0.286	94.1	8.3	10	32.0	812.3
40.0	2.827	0.555	101.2	15.5	12	29.5	803.8
41.0	2.907	0.727	89.8	23.5	14	27.8	837.7
42.0	2.934	0.928	39.0	69.8	16	23.8	856.1
43.0	2.962	0.989	8.2	357.2	18	22.0	871.2
44.0	3.110	0.996	2.7	1147.5	20	19.4	866.5
					22	16.9	876.8
					24	15.2	877.4
					26	13.6	898.6
					28	10.5	904.4
					30	9.7	901.3
					32	8.8	890.8
					34	7.9	847.5
					36	29.3	830.5
					38	21.5	741.7
					40	12.2	691.7
					42	6.0	489.8
					44	4.2	296.3

x = 0mm, y = 0mm			Exp. DT5		Q_w = 34L/s	D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
179.5	1.808	0.001	0.6	3.4	145.5	3.2	523.6
180.5	2.990	0.072	7.6	28.3	147.5	5.7	734.1
181.0	3.274	0.244	19.4	41.2	149.5	8.4	833.6
181.5	2.962	0.091	14.8	18.3	151.5	11.3	881.9
182.0	4.642	0.255	23.4	50.6	153.5	11.7	919.7
182.5	3.274	0.550	20.2	89.2	155.5	13.2	939.3
183.0	3.309	0.429	33.0	43.0	157.5	14.3	944.3
183.5	3.019	0.579	26.1	67.0	159.5	14.8	950.9
184.0	3.309	0.695	24.1	95.4	161.5	15.9	951.6
184.5	2.728	0.885	10.0	241.4	163.5	16.6	951.9
185.0	4.147	0.874	10.3	352.0	165.5	15.9	953.6
185.5	3.049	0.894	10.5	259.5	167.5	15.9	952.8
186.5	3.793	0.988	2.4	1560.9	169.5	15.1	951.3
					171.5	16.5	951.4
					173.5	17.2	950.1
					175.5	17.2	950.2
					177.5	14.6	931.9
					179.5	10.0	762.3
					181.5	4.9	543.0
					183.5	2.9	322.5

x = 25mm, y = 0mm			Exp. DT5	Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
142.50	2.934	0.999	2.3	1274.5	144	2.9	152.6
143.00	2.827	0.967	54.0	50.6	146	2.2	616.3
143.25	2.827	0.901	137.9	18.5	148	5.4	751.1
143.50	2.777	0.687	282.1	6.8	150	7.3	852.9
143.75	2.907	0.421	330.7	3.7	152	10.5	894.2
144.00	2.853	0.164	211.4	2.2	154	11.3	929.8
144.50	2.827	0.010	24.6	1.1	156	11.6	943.7
180.00	3.456	0.018	5.7	11.2	158	14.1	943.8
181.00	3.049	0.075	12.0	19.0	160	13.3	950.0
182.00	3.937	0.365	22.8	63.0	162	15.1	952.0
182.50	3.274	0.388	20.5	62.0	164	15.6	951.5
183.00	3.418	0.547	29.8	62.7	166	15.2	952.9
183.50	2.962	0.676	24.1	83.0	168	14.4	951.4
184.00	3.702	0.731	24.2	111.9	170	14.2	951.0
184.50	4.443	0.834	16.6	223.2	172	12.3	950.4
185.00	3.937	0.877	13.3	259.7	174	14.0	952.2
186.00	5.016	0.996	1.2	4163.4	176	13.7	949.8
187.00	5.016	0.996	0.5	9993.0	178	11.9	936.2
					180	8.8	793.6
					182	5.1	514.4
					184	3.3	387.5

x = 50mm, y = 0mm			Exp. DT5	Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
141.00	2.704	0.992	11.6	231.3	144	2.0	648.6
141.50	2.827	0.947	61.0	43.9	146	0.6	745.0
142.00	2.934	0.819	165.1	14.6	148	-0.2	813.4
142.25	2.880	0.583	226.3	7.4	150	-1.9	861.3
142.50	2.934	0.460	259.2	5.2	152	-3.2	890.4
142.75	2.962	0.344	239.9	4.2	154	-4.5	910.8
143.00	3.019	0.182	179.7	3.1	156	-4.7	934.4
143.50	3.049	0.050	74.2	2.0	158	-6.0	939.9
144.00	3.049	0.008	14.6	1.6	160	-6.2	946.7
179.00	2.237	0.018	5.1	8.0	162	-6.3	947.4
180.00	2.777	0.062	8.4	20.6	164	-5.9	948.9
181.00	2.880	0.201	20.0	29.0	166	-5.0	949.6
181.50	3.173	0.353	36.3	30.8	168	-4.3	950.1
182.00	3.206	0.607	30.5	63.8	170	-3.6	948.4
182.50	4.380	0.507	29.2	76.0	172	10.6	947.6
183.00	4.507	0.811	22.0	166.2	174	16.8	947.9
183.50	3.418	0.862	21.1	139.6	176	16.3	944.7

184.00	4.039	0.971	7.0	560.3	178	13.1	938.1
185.00	2.880	0.981	3.7	763.4	180	8.8	844.4
					182	4.1	473.1
					184	3.9	209.9

x = 100mm, y = 0mm			Exp. DT5	Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
136.5	2.990	0.989	9.5	311.3	139	7.5	589.4
137.5	2.990	0.935	51.9	53.9	141	10.4	650.6
138.0	3.019	0.866	90.5	28.9	143	14.3	715.9
138.5	3.049	0.767	124.3	18.8	145	17.9	810.0
139.0	2.934	0.606	154.1	11.5	147	21.2	827.4
139.5	3.049	0.391	170.6	7.0	149	23.1	886.9
140.0	3.079	0.179	109.9	5.0	151	23.6	910.2
140.5	3.173	0.161	98.9	5.2	153	24.5	929.2
141.0	3.206	0.137	89.3	4.9	155	25.5	932.8
142.0	3.344	0.014	13.3	3.5	157	24.4	940.4
175.0	1.968	0.004	1.5	5.9	159	24.8	942.0
176.0	3.659	0.047	8.9	19.5	161	24.3	945.3
177.0	3.747	0.060	10.7	21.2	163	23.9	946.4
177.5	3.240	0.136	17.7	24.9	165	23.4	947.2
178.0	2.962	0.237	26.4	26.6	167	21.6	946.6
178.5	3.141	0.466	33.8	43.3	169	19.6	947.7
179.0	3.380	0.599	26.2	77.3	171	18.2	947.3
179.5	3.344	0.613	32.5	63.1	173	16.5	945.7
180.0	3.309	0.775	23.7	108.2	175	14.0	943.2
180.5	4.319	0.925	10.3	388.0	177	8.6	885.8
181.0	3.274	0.819	20.1	133.3	179	3.8	618.3
182.0	4.642	0.987	2.6	1762.7			
183.0	4.092	0.987	1.6	2524.0			

x = 200mm, y = 0mm			Exp. DT5	Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
118.0	3.049	0.998	1.9	1601.2	126	11.7	620.0
120.0	3.206	0.972	13.8	225.7	128	18.1	719.0
121.0	3.079	0.949	24.9	117.4	130	21.3	755.6
122.0	3.141	0.911	40.3	71.0	132	24.0	813.0
123.0	3.274	0.788	76.1	33.9	134	26.7	852.9
124.0	3.240	0.561	111.4	16.3	136	27.8	885.4
125.0	3.274	0.425	102.9	13.5	138	29.6	917.8
126.0	3.240	0.179	65.7	8.8	140	30.2	912.4
127.0	3.274	0.264	69.6	12.4	142	30.1	933.8
128.0	3.240	0.079	36.2	7.0	144	29.3	938.9

129.0	3.380	0.049	18.4	8.9	146	19.2	949.1
130.0	3.344	0.049	16.6	10.0	148	29.0	950.2
132.0	3.616	0.049	22.9	7.8	150	19.4	950.2
165.0	3.049	0.042	5.2	24.7	152	25.0	952.2
166.0	3.240	0.123	15.9	25.1	154	22.1	951.9
167.0	3.309	0.292	28.6	33.8	156	23.1	951.4
168.0	3.534	0.377	34.3	38.9	158	19.0	945.9
169.0	3.534	0.611	30.5	70.8	160	18.2	947.6
170.0	3.418	0.894	15.8	193.4	162	14.1	919.2
171.0	3.747	0.942	8.7	405.8	164	10.1	813.0
172.0	3.141	0.993	1.8	1733.1	166	7.0	477.8
173.0	4.319	0.990	1.9	2251.0	168	7.1	223.0
					170	6.9	196.2

x = 300mm, y = 0mm			Exp. DT5	Q_w = 34L/s	D = 60mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
90.0	3.141	0.988	4.5	689.6	102	-3.8	112.0
93.0	3.206	0.968	13.7	226.4	104	-3.9	116.9
96.0	3.274	0.765	59.5	42.1	106	-3.7	128.6
98.0	3.309	0.727	65.0	37.0	108	-3.4	157.6
100.0	3.309	0.566	65.6	28.5	110	-2.7	217.2
102.0	3.240	0.298	49.1	19.7	112	-2.1	329.7
104.0	3.380	0.275	40.4	23.0	114	-1.2	449.8
106.0	3.418	0.133	36.1	12.6	116	1.1	612.7
108.0	3.418	0.243	56.6	14.7	118	2.1	725.1
110.0	3.380	0.043	14.7	9.9	120	5.6	799.5
113.0	3.380	0.027	14.5	6.4	122	8.9	848.6
116.0	3.418	0.011	6.7	5.8	124	10.3	877.5
143.0	3.019	0.035	6.2	17.1	126	13.2	907.5
145.0	3.380	0.014	2.9	16.0	128	11.7	912.3
146.0	3.173	0.028	3.9	22.7	130	12.1	930.4
147.0	3.110	0.023	3.4	20.9	132	10.5	942.2
148.0	3.380	0.117	10.8	36.8	134	11.6	941.0
149.0	3.534	0.089	13.0	24.3	136	11.5	941.3
150.0	3.380	0.301	23.4	43.4	138	10.5	934.3
151.0	3.418	0.480	33.5	48.9	140	7.9	932.2
152.0	3.309	0.634	32.5	64.5	142	6.8	893.1
153.0	3.418	0.804	23.4	117.4	144	7.9	836.4
154.0	3.534	0.901	15.3	208.1	146	5.2	770.6
155.0	3.534	0.976	7.2	479.2	148	1.6	536.4
157.0	3.616	0.997	1.0	3604.1	150	0.6	479.4

x = 400mm, y = 0mm		Exp. DT5	Q_w = 34L/s			D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
65.0	3.418	0.999	0.5	6828.7	81	-2.1	228.1
70.0	3.344	0.960	13.9	230.9	83	-1.1	378.0
72.0	3.274	0.964	9.2	343.2	85	0.4	477.0
74.0	3.418	0.851	33.5	86.8	87	2.5	471.5
76.0	3.380	0.804	34.3	79.2	89	5.9	564.4
78.0	3.456	0.645	53.1	42.0	91	6.7	642.2
80.0	3.456	0.549	48.7	39.0	93	8.9	649.2
82.0	3.494	0.628	36.8	59.6	95	13.5	789.3
84.0	3.534	0.716	34.5	73.4	97	3.5	767.5
86.0	3.534	0.424	40.6	36.9	99	15.8	838.9
88.0	3.575	0.465	47.7	34.9	101	-4.6	853.2
90.0	3.418	0.202	42.5	16.2	103	19.5	898.5
95.0	3.575	0.230	50.0	16.5	105	3.5	915.4
100.0	3.575	0.035	13.2	9.4	107	10.4	925.6
105.0	3.380	0.010	4.5	7.2	109	0.8	927.7
120.0	3.019	0.015	1.4	33.3	111	17.1	938.6
122.0	3.418	0.042	5.7	25.0	113	12.8	944.2
124.0	3.380	0.060	7.7	26.2	115	10.3	943.2
125.0	3.309	0.140	14.9	31.0	117	13.5	943.6
126.0	3.274	0.191	19.7	31.8	119	9.2	935.4
127.0	3.344	0.276	28.9	32.0	121	11.0	934.2
128.0	3.456	0.437	29.1	51.9	123	8.2	898.8
129.0	3.534	0.430	29.6	51.4	125	7.3	905.9
131.0	3.702	0.874	16.5	196.1	127	1.5	747.4
133.0	4.507	0.988	2.7	1648.6	129	-1.5	537.3
135.0	4.039	0.999	0.4	10091.5			

x = 400mm, y = 25mm		Exp. DT5	Q_w = 34L/s			D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
70.0	3.888	0.999	0.8	4852.9	86	1.8	531.8
74.0	3.659	0.994	3.9	932.9	86	-0.8	601.2
76.0	3.659	0.994	3.8	956.8	88	-1.1	705.7
78.0	3.747	0.947	24.8	143.0	90	0.6	732.0
80.0	3.702	0.876	42.6	76.1	92	1.9	854.6
82.0	3.747	0.801	59.7	50.3	94	3.0	856.4
84.0	3.702	0.707	70.9	36.9	96	3.3	877.3
86.0	3.702	0.471	84.4	20.7	98	4.5	919.6
88.0	3.702	0.475	75.1	23.4	100	6.1	930.3
90.0	3.659	0.149	46.6	11.7	102	3.1	915.7
92.0	3.616	0.183	43.7	15.1	104	-2.5	903.4
95.0	3.616	0.066	25.9	9.2	106	10.5	904.5

100.0	3.575	0.038	12.1	11.3	108	7.4	878.1
103.0	3.344	0.015	3.4	14.9	110	10.8	833.4
106.0	3.344	0.086	11.4	25.3	112	9.5	733.3
109.0	3.534	0.165	14.3	40.7	114	6.9	716.2
112.0	3.309	0.277	21.7	42.3	116	5.4	631.0
114.0	3.534	0.462	23.8	68.7	118	2.1	443.7
116.0	3.494	0.428	21.9	68.3			
118.0	3.380	0.502	17.1	99.2			
120.0	3.534	0.727	16.6	154.8			
122.0	3.494	0.892	13.4	232.5			
124.0	3.616	0.923	9.0	370.9			
127.0	3.575	0.939	6.2	541.1			
130.0	3.456	0.992	2.0	1713.4			

x = 400mm, y = 50mm			Exp. DT5		Q_w = 34L/s	D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
75.0	3.659	0.995	3.0	1213.2	83	-0.9	566.9
78.0	3.793	0.948	24.6	146.2	85	0.7	749.1
80.0	3.840	0.851	54.1	60.4	87	1.5	793.3
82.0	3.840	0.704	85.6	31.6	89	4.0	868.0
84.0	3.793	0.389	89.8	16.4	91	5.9	893.8
86.0	3.793	0.195	59.4	12.5	93	9.2	924.7
88.0	3.747	0.082	33.1	9.2	95	12.2	939.0
90.0	3.747	0.037	15.3	9.1	97	10.6	943.8
92.0	3.659	0.026	9.7	9.9	99	9.5	935.4
95.0	1.840	0.000	0.4	1.9	101	11.9	920.9
105.0	3.494	0.027	2.2	43.5	103	11.5	935.8
110.0	3.344	0.114	4.6	83.0	105	9.9	910.3
115.0	3.344	0.189	9.4	67.1	107	10.5	919.7
120.0	3.534	0.123	9.4	46.2	109	10.1	854.3
124.0	3.380	0.126	13.9	30.6	111	4.7	931.9
127.0	3.534	0.164	19.3	30.0	113	2.8	908.5
130.0	3.575	0.440	30.8	51.1	115	5.3	898.8
133.0	3.534	0.463	30.4	53.9	117	2.5	819.6
136.0	3.616	0.681	27.8	88.5	119	-0.6	781.0
139.0	3.616	0.842	20.8	146.3	121	-0.2	844.2
142.0	3.534	0.944	9.6	347.5	123	-2.4	733.0
146.0	3.616	0.998	0.6	6012.3	125	-1.1	771.8
					127	-1.5	669.2
					129	-2.1	704.7
					131	-1.5	682.1
					133	-1.7	530.5

x = 400mm, y = 75mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
75.0	3.747	0.998	1.7	2199.8	84	-1.8	494.1
78.0	3.793	0.970	14.8	248.5	86	-1.1	730.3
80.0	3.888	0.940	27.7	131.9	88	0.5	753.4
82.0	3.888	0.749	67.2	43.4	90	3.8	881.6
84.0	3.888	0.631	81.9	30.0	92	4.4	886.3
86.0	3.888	0.425	99.6	16.6	94	1.2	920.8
88.0	3.840	0.309	78.8	15.0	96	8.6	939.2
90.0	3.793	0.134	49.9	10.2	98	10.0	937.6
92.0	3.793	0.048	26.5	6.9	100	12.5	937.1
94.0	3.659	0.016	9.7	5.9	102	0.6	931.3
96.0	3.240	0.007	5.3	4.4	104	8.3	930.9
100.0	3.079	0.004	3.4	4.0	106	14.0	933.9
105.0	3.206	0.003	3.3	3.1	108	15.3	927.9
110.0	3.173	0.020	12.0	5.4	110	14.1	934.1
115.0	3.344	0.133	31.2	14.3	112	15.1	884.6
118.0	3.418	0.189	32.9	19.7	114	12.2	880.4
121.0	3.456	0.326	31.9	35.3	116	12.8	909.2
124.0	3.456	0.477	37.3	44.2	118	12.0	828.9
127.0	3.534	0.644	31.6	72.0	120	8.8	781.4
130.0	3.494	0.846	21.9	135.0	122	5.7	698.4
133.0	3.747	0.953	9.4	379.9	124	6.6	769.7
136.0	3.702	0.985	4.4	828.4	126	1.7	538.8
139.0	5.016	1.000	0.2	25077.5	128	-0.1	626.4
142.0	5.016	1.000	1.3	3857.0			

x = 400mm, y = 100mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
65.0	3.344	0.993	2.6	1276.6	80	-3.5	463.1
70.0	3.344	0.981	7.4	443.4	82	-2.8	546.4
72.0	3.380	0.904	32.8	93.2	84	-1.2	610.1
74.0	3.380	0.885	33.9	88.2	86	1.1	693.9
76.0	3.456	0.818	48.7	58.1	88	4.1	680.4
78.0	3.456	0.683	64.4	36.7	90	4.5	750.7
80.0	3.418	0.567	78.0	24.9	92	6.7	813.9
82.0	3.418	0.272	67.5	13.8	94	8.6	815.2
84.0	3.494	0.329	70.0	16.4	96	8.8	849.2
86.0	3.380	0.148	41.8	12.0	98	3.7	868.5
88.0	3.344	0.075	25.4	9.9	100	10.7	895.4
90.0	3.494	0.065	25.4	8.9	102	13.1	898.8
95.0	3.494	0.019	9.1	7.3	104	12.0	879.9
100.0	3.141	0.006	5.6	3.5	106	10.7	874.7

105.0	3.141	0.028	20.0	4.4	108	7.7	883.9
108.0	3.173	0.058	34.1	5.4	110	4.6	843.0
110.0	3.206	0.062	38.2	5.2	112	5.5	789.1
112.0	3.309	0.155	51.3	10.0	114	2.9	745.6
114.0	3.418	0.260	63.1	14.1	116	1.2	532.2
116.0	3.534	0.393	71.5	19.4	118	0.8	499.0
118.0	3.534	0.470	81.4	20.4	120	-0.8	395.3
120.0	3.575	0.575	63.8	32.2			
122.0	3.616	0.780	53.7	52.5			
124.0	3.616	0.860	36.3	85.6			
126.0	3.575	0.943	17.9	188.3			
128.0	3.616	0.979	8.7	407.0			
131.0	3.575	0.997	1.8	1979.2			

x = 400mm, y = 120mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
50.0	3.494	0.754	65.8	40.1			
55.0	3.575	0.830	54.1	54.9			
60.0	3.575	0.837	53.1	56.3			
65.0	3.616	0.796	65.2	44.2			
70.0	3.659	0.741	82.4	32.9			
75.0	3.659	0.665	99.9	24.4			
80.0	3.702	0.634	108.7	21.6			
85.0	3.747	0.654	101.8	24.1			
90.0	3.793	0.635	97.4	24.7			
95.0	3.793	0.687	87.3	29.9			
100.0	3.840	0.769	75.5	39.1			
105.0	3.747	0.901	37.6	89.8			
110.0	3.747	0.947	22.4	158.4			
115.0	3.702	0.990	5.1	718.9			
120.0	3.840	0.997	2.0	1913.2			

x = 500mm, y = 0mm		Exp. DT5		Q_w = 34L/s		D = 60mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	P [mm]	H [mm]
48.0	3.079	0.351	104.6	10.3	48	11.3	269.4
50.0	3.309	0.580	132.7	14.5	50	10.4	271.8
52.0	3.141	0.312	96.1	10.2	52	9.9	372.2
54.0	3.240	0.404	115.3	11.4	54	6.5	259.3
56.0	3.309	0.304	78.3	12.8	56	8.2	298.2
58.0	3.274	0.307	87.6	11.5	58	12.9	417.8
60.0	3.494	0.246	59.2	14.5	60	10.6	458.5
63.0	3.494	0.208	54.5	13.3	62	13.1	592.6
66.0	3.534	0.214	47.8	15.8	64	4.4	609.0

70.0	3.616	0.061	20.6	10.7
75.0	3.456	0.019	7.3	9.0
80.0	3.274	0.009	3.1	9.8
85.0	3.575	0.018	3.0	21.6
90.0	3.418	0.043	5.5	26.5
93.0	3.534	0.131	14.3	32.4
95.0	3.616	0.152	16.9	32.6
96.0	3.575	0.320	25.6	44.7
97.0	3.616	0.349	25.9	48.7
98.0	3.702	0.577	30.3	70.5
99.0	3.534	0.724	27.6	92.7
100.0	3.840	0.805	25.6	120.7
101.0	3.380	0.869	20.0	146.8
102.0	3.575	0.928	9.7	342.0
105.0	3.274	0.989	1.3	2490.5
110.0	5.016	1.000	0.2	25071.9

66	12.8	757.2
68	7.5	733.2
70	2.4	747.0
72	9.1	773.3
74	-2.1	842.7
76	3.5	837.7
78	6.8	898.5
80	0.4	915.7
82	13.7	921.5
84	14.2	926.8
86	7.7	931.4
88	7.6	925.9
90	13.1	944.4
92	10.1	920.8
94	7.7	899.8
96	5.2	856.1
98	2.4	767.3

x = 600mm, y = 0mm		Exp. DT5	Q_w = 34L/s		D = 60mm		x = 600mm, y = 25mm		
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.456	0.153	167.5	3.2	5.0	5.016	0.163	184.7	4.4
9.0	2.802	0.175	187.3	2.6	9.0	2.934	0.163	183.0	2.6
12.0	1.840	0.183	192.9	1.7	12.0	2.528	0.179	200.4	2.3
15.0	2.549	0.165	182.0	2.3	15.0	2.658	0.166	198.0	2.2
18.0	2.681	0.163	169.8	2.6	18.0	2.827	0.148	166.6	2.5
21.0	3.079	0.144	147.4	3.0	21.0	3.309	0.147	161.8	3.0
24.0	3.110	0.148	158.0	2.9	24.0	3.240	0.108	115.6	3.0
27.0	2.962	0.107	113.0	2.8	27.0	2.990	0.092	107.8	2.6
30.0	3.344	0.107	106.6	3.4	30.0	3.079	0.106	119.2	2.7
33.0	3.418	0.082	79.7	3.5	33.0	3.240	0.054	58.4	3.0
36.0	3.274	0.068	70.4	3.2	36.0	3.309	0.026	27.2	3.2
39.0	3.534	0.038	34.5	3.9	39.0	2.934	0.059	35.2	4.9
42.0	3.494	0.017	12.6	4.7	42.0	3.344	0.101	24.0	14.0
45.0	3.888	0.013	7.0	7.1	44.0	2.880	0.125	25.4	14.2
48.0	3.380	0.032	13.4	8.2	46.0	3.141	0.355	34.1	32.7
50.0	3.840	0.077	15.6	18.9	48.0	3.110	0.344	26.5	40.4
52.0	3.616	0.123	19.7	22.5	50.0	3.575	0.523	27.4	68.3
54.0	3.937	0.237	22.7	41.2	52.0	3.456	0.717	26.4	93.8
56.0	3.019	0.368	24.8	44.8	54.0	3.616	0.740	25.4	105.3
58.0	4.785	0.296	20.9	67.7	56.0	3.747	0.872	15.5	210.7
60.0	3.206	0.447	26.0	55.2	58.0	3.747	0.906	13.0	261.2
62.0	3.987	0.862	15.6	220.4	60.0	3.747	0.925	10.6	326.9
65.0	3.659	0.923	8.7	388.1	62.0	4.574	0.975	4.0	1115.2
70.0	4.574	0.995	1.2	3791.9	65.0	5.016	0.992	1.4	3554.2

x = 600mm, y = 50mm				Exp. DT5		Q_w = 34L/s		D = 60mm	x = 600mm, y = 75mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.338	0.166	176.4	2.2	5.0	1.885	0.108	132.4	1.5
9.0	2.570	0.154	180.6	2.2	9.0	2.073	0.132	155.0	1.8
12.0	2.752	0.150	183.6	2.3	12.0	2.356	0.126	159.5	1.9
15.0	2.528	0.151	186.0	2.1	15.0	2.449	0.145	180.4	2.0
18.0	3.534	0.124	143.3	3.1	18.0	2.681	0.159	196.0	2.2
21.0	2.907	0.109	121.0	2.6	21.0	2.827	0.139	178.0	2.2
24.0	3.141	0.083	91.1	2.9	24.0	3.173	0.148	184.2	2.6
27.0	3.534	0.042	46.0	3.2	27.0	3.240	0.114	141.2	2.6
30.0	3.659	0.028	30.1	3.4	30.0	3.494	0.092	104.0	3.1
33.0	3.747	0.009	10.6	3.3	33.0	3.616	0.073	76.8	3.4
36.0	3.659	0.005	6.2	3.1	36.0	3.616	0.043	49.6	3.2
39.0	3.987	0.004	3.1	4.7	39.0	3.616	0.030	30.1	3.6
42.0	5.016	0.010	4.1	12.8	42.0	3.616	0.041	35.3	4.2
45.0	3.840	0.016	4.0	15.4	44.0	3.616	0.070	33.7	7.5
48.0	4.203	0.044	8.2	22.7	46.0	3.659	0.198	48.1	15.1
50.0	3.494	0.061	9.7	22.1	48.0	3.840	0.210	50.8	15.9
52.0	3.937	0.057	10.4	21.4	50.0	3.793	0.422	56.4	28.4
54.0	3.702	0.122	17.3	26.1	52.0	4.039	0.604	47.2	51.7
56.0	3.937	0.117	23.4	19.8	54.0	3.987	0.748	33.4	89.3
58.0	3.987	0.233	28.2	32.9	56.0	3.888	0.854	22.6	146.8
60.0	3.840	0.287	39.7	27.8	58.0	3.494	0.888	13.6	228.1
62.0	4.785	0.641	34.1	89.9	60.0	3.049	0.954	8.5	342.2
64.0	3.747	0.733	32.3	85.1	62.0	4.507	0.987	2.3	1933.9
66.0	4.092	0.802	26.3	124.8					
68.0	3.659	0.880	19.9	161.8					
70.0	2.802	0.954	9.9	270.0					

x = 600mm, y = 100mm				Exp. DT5		Q_w = 34L/s		D = 60mm	x = 600mm, y = 120mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.338	0.096	148.5	1.5	5.0	1.932	0.068	98.1	1.3
9.0	2.145	0.122	164.7	1.6	10.0	1.956	0.092	132.4	1.4
12.0	2.636	0.132	172.4	2.0	15.0	2.449	0.091	145.4	1.5
15.0	2.728	0.136	164.7	2.3	20.0	2.570	0.094	156.1	1.6
18.0	2.827	0.139	162.9	2.4	24.0	2.704	0.118	183.5	1.7
21.0	3.173	0.122	138.1	2.8	28.0	2.934	0.150	222.3	2.0
24.0	3.380	0.108	114.6	3.2	32.0	3.079	0.204	251.2	2.5
27.0	3.534	0.087	85.1	3.6	36.0	2.907	0.320	308.2	3.0
30.0	3.575	0.092	90.3	3.7	40.0	3.110	0.407	298.7	4.2
32.0	3.575	0.063	62.0	3.6	44.0	3.019	0.486	257.1	5.7
34.0	3.702	0.084	57.4	5.4	48.0	3.079	0.548	254.2	6.6
36.0	3.747	0.124	51.1	9.1	52.0	2.752	0.595	176.3	9.3
38.0	3.793	0.175	59.2	11.2	56.0	2.728	0.708	112.5	17.2

40.0	3.888	0.260	65.0	15.5
42.0	3.840	0.393	53.4	28.3
44.0	3.747	0.543	61.3	33.2
46.0	3.840	0.676	48.6	53.4
48.0	3.702	0.866	31.2	102.7
50.0	3.840	0.932	22.6	158.3
52.0	3.534	0.969	11.4	300.4
55.0	2.681	0.994	3.4	783.5
60.0	2.060	0.998	2.0	1027.7

60.0	2.570	0.736	102.2	18.5
64.0	2.356	0.834	54.9	35.8
68.0	2.160	0.933	22.4	89.9
72.0	2.528	0.962	14.3	170.1
76.0	1.329	0.982	7.7	169.5
80.0	1.174	0.995	1.7	686.7

x = 700mm, y = 0mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 700mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.962	0.036	102.2	1.0	5.0	3.019	0.049	130.3	1.1
9.0	2.962	0.056	137.1	1.2	10.0	3.049	0.069	149.6	1.4
12.0	3.240	0.068	161.6	1.4	15.0	3.206	0.080	161.0	1.6
15.0	3.079	0.079	157.7	1.5	20.0	3.309	0.075	134.0	1.8
18.0	3.049	0.092	176.7	1.6	25.0	3.274	0.075	125.9	1.9
21.0	3.309	0.074	145.9	1.7	30.0	3.494	0.049	90.3	1.9
24.0	3.309	0.092	167.3	1.8	35.0	3.456	0.056	87.0	2.2
27.0	3.173	0.106	175.3	1.9	38.0	3.575	0.101	97.6	3.7
30.0	3.240	0.061	103.4	1.9	40.0	3.616	0.201	87.9	8.3
33.0	3.456	0.068	108.5	2.2	42.0	3.793	0.315	124.5	9.6
36.0	3.616	0.060	81.5	2.7	44.0	3.793	0.396	108.4	13.9
38.0	3.616	0.077	58.9	4.7	46.0	3.937	0.515	129.5	15.7
40.0	3.494	0.258	69.7	12.9	48.0	3.937	0.582	133.9	17.1
42.0	3.344	0.493	73.8	22.3	50.0	3.987	0.656	136.8	19.1
44.0	3.494	0.608	72.7	29.2	52.0	3.937	0.719	154.1	18.4
46.0	3.418	0.811	46.1	60.2	54.0	3.937	0.782	136.9	22.5
48.0	3.575	0.885	39.6	79.9	56.0	3.987	0.823	116.7	28.1
50.0	3.747	0.938	36.2	97.1	58.0	3.840	0.842	117.7	27.5
52.0	3.747	0.967	24.2	149.7	60.0	3.937	0.864	114.9	29.6
54.0	3.793	0.982	22.7	164.1	63.0	3.987	0.910	80.7	45.0
57.0	3.840	0.987	17.5	216.6	66.0	3.793	0.940	55.1	64.7
60.0	3.659	0.989	17.2	210.3	70.0	4.092	0.974	30.8	129.4
65.0	3.747	0.994	10.5	354.6	75.0	4.147	0.975	28.1	143.8
70.0	3.659	0.991	15.2	238.5	80.0	4.443	0.989	13.0	338.1
					90.0	3.937	0.995	6.4	611.9

x = 700mm, y = 50mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 700mm, y = 75mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.240	0.052	129.9	1.3	5.0	3.206	0.072	157.0	1.5
10.0	3.240	0.066	126.4	1.7	10.0	3.141	0.088	177.1	1.6
15.0	3.079	0.059	106.2	1.7	15.0	3.079	0.091	158.9	1.8

20.0	3.456	0.047	70.3	2.3	20.0	3.173	0.065	108.6	1.9
25.0	3.494	0.036	51.9	2.4	25.0	3.309	0.059	94.8	2.1
28.0	3.380	0.016	24.3	2.2	29.0	3.380	0.041	64.5	2.1
30.0	3.418	0.007	12.0	2.0	32.0	3.344	0.052	61.0	2.9
32.0	3.659	0.012	12.5	3.5	34.0	3.494	0.118	53.5	7.7
33.0	3.616	0.027	26.5	3.6	35.0	3.575	0.108	63.6	6.1
34.0	3.747	0.015	11.4	4.9	36.0	3.456	0.304	69.5	15.1
35.0	3.380	0.043	19.2	7.6	37.0	3.534	0.448	77.5	20.4
36.0	3.344	0.114	28.4	13.4	38.0	3.575	0.542	76.7	25.3
37.0	3.616	0.194	53.6	13.1	39.0	3.575	0.587	80.8	26.0
38.0	3.702	0.442	50.6	32.3	40.0	3.616	0.634	76.6	29.9
39.0	3.534	0.569	48.0	41.9	41.0	3.659	0.777	49.8	57.1
40.0	3.616	0.752	39.7	68.5	42.0	3.747	0.727	79.7	34.2
42.0	3.575	0.876	34.0	92.1	43.0	3.840	0.861	43.1	76.7
44.0	3.616	0.950	16.5	208.2	44.0	3.840	0.821	61.3	51.5
47.0	3.793	0.978	12.0	309.2	45.0	3.793	0.847	49.8	64.5
50.0	3.937	0.994	6.0	652.2	47.0	3.840	0.926	27.2	130.7
55.0	4.203	0.995	5.3	788.9	50.0	3.937	0.940	24.7	149.9
60.0	3.888	0.994	6.9	559.9	55.0	3.888	0.975	15.7	241.4
70.0	4.147	0.995	5.4	764.3	60.0	3.747	0.996	3.6	1036.5
80.0	3.575	0.997	4.1	869.3	70.0	2.468	0.999	1.1	2241.8

x = 700mm, y = 100mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 700mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.704	0.047	113.2	1.1	5.0	2.488	0.031	80.4	1.0
10.0	2.934	0.066	147.3	1.3	10.0	2.827	0.049	110.1	1.3
15.0	2.990	0.082	164.0	1.5	15.0	2.853	0.052	117.6	1.3
20.0	3.079	0.089	166.7	1.7	20.0	3.019	0.062	133.0	1.4
25.0	3.344	0.114	189.1	2.0	25.0	2.934	0.059	133.5	1.3
28.0	3.456	0.117	151.2	2.7	30.0	3.206	0.080	158.0	1.6
30.0	3.534	0.165	164.0	3.6	35.0	3.019	0.147	202.2	2.2
32.0	3.534	0.245	175.0	4.9	40.0	3.456	0.252	249.7	3.5
34.0	3.575	0.432	144.0	10.7	45.0	3.418	0.393	288.5	4.7
36.0	3.575	0.566	160.7	12.6	50.0	3.659	0.525	301.3	6.4
38.0	3.659	0.726	128.3	20.7	55.0	3.616	0.583	279.3	7.5
40.0	3.659	0.794	93.6	31.1	60.0	3.494	0.620	247.1	8.8
42.0	3.494	0.868	80.3	37.8	65.0	3.575	0.616	234.2	9.4
45.0	3.418	0.912	61.5	50.7	70.0	3.702	0.588	211.8	10.3
50.0	3.049	0.949	41.2	70.2	75.0	3.494	0.658	171.4	13.4
55.0	2.592	0.965	28.7	87.2	80.0	3.206	0.661	145.4	14.6
60.0	2.528	0.966	27.6	88.5	85.0	2.190	0.750	95.1	17.3
65.0	2.270	0.956	32.2	67.4	90.0	1.981	0.809	71.2	22.5
70.0	2.237	0.949	30.8	68.9	95.0	1.787	0.903	38.2	42.3
75.0	2.033	0.942	33.1	57.8	100.0	1.672	0.936	21.6	72.5

80.0	1.981	0.937	33.1	56.1
85.0	1.994	0.951	22.0	86.2
90.0	2.130	0.970	13.9	148.7
95.0	1.908	0.970	13.2	140.2
100.0	1.873	0.976	11.7	156.3
110.0	1.547	0.991	4.6	333.3
120.0	1.341	0.998	1.0	1337.8

105.0	1.620	0.945	19.0	80.6
110.0	1.603	0.984	7.1	222.2
115.0	1.571	0.991	4.2	370.5
120.0	2.270	0.995	2.5	903.0
130.0	2.907	1.000	0.3	9686.8

x = 800mm, y = 0mm Exp. DT5 Q_w = 34L/s D = 60mm x = 800mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.110	0.029	85.3	1.1
15.0	3.173	0.053	121.6	1.4
20.0	3.141	0.066	131.0	1.6
22.0	3.206	0.059	106.4	1.8
24.0	3.309	0.082	143.4	1.9
26.0	3.206	0.091	135.7	2.2
28.0	3.309	0.093	131.4	2.3
30.0	3.344	0.169	141.7	4.0
32.0	3.380	0.237	139.5	5.7
34.0	3.380	0.410	131.7	10.5
36.0	3.418	0.442	161.6	9.4
38.0	3.456	0.549	142.8	13.3
40.0	3.494	0.693	121.6	19.9
42.0	3.494	0.729	116.1	21.9
44.0	3.575	0.738	126.6	20.8
46.0	3.534	0.820	111.0	26.1
48.0	3.616	0.851	81.3	37.9
50.0	3.616	0.875	81.4	38.9
55.0	3.659	0.926	56.4	60.1
60.0	3.702	0.950	50.3	69.9
70.0	3.659	0.970	33.9	104.7
85.0	3.840	0.986	21.5	176.0
100.0	3.937	0.990	15.4	253.1

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.141	0.036	94.9	1.2
10.0	3.173	0.047	107.9	1.4
15.0	3.173	0.066	143.6	1.5
20.0	3.173	0.078	145.0	1.7
25.0	3.206	0.103	150.6	2.2
30.0	3.344	0.139	147.3	3.1
33.0	3.380	0.212	155.4	4.6
36.0	3.494	0.250	182.5	4.8
39.0	3.534	0.389	146.2	9.4
42.0	3.616	0.404	152.8	9.6
45.0	3.702	0.594	149.9	14.7
48.0	3.747	0.721	146.1	18.5
51.0	3.840	0.707	137.2	19.8
54.0	3.840	0.723	129.1	21.5
57.0	3.840	0.812	108.3	28.8
60.0	3.888	0.843	112.7	29.1
65.0	3.888	0.878	91.6	37.3
70.0	3.888	0.899	78.5	44.5
80.0	3.888	0.950	42.6	86.7
95.0	3.937	0.981	26.4	146.3
110.0	4.092	0.993	8.5	478.2

x = 800mm, y = 50mm Exp. DT5 Q_w = 34L/s D = 60mm x = 800mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.309	0.035	90.9	1.3
12.0	3.274	0.051	116.6	1.4
18.0	3.309	0.068	113.7	2.0
21.0	3.380	0.069	83.7	2.8
24.0	3.380	0.191	98.7	6.5
26.0	3.456	0.278	104.0	9.2
28.0	3.418	0.429	86.9	16.9

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.079	0.060	136.8	1.4
12.0	3.274	0.066	132.3	1.6
16.0	3.274	0.064	115.1	1.8
20.0	3.274	0.089	116.5	2.5
22.0	3.418	0.100	110.9	3.1
24.0	3.309	0.132	112.0	3.9
26.0	3.380	0.250	110.6	7.6

30.0	3.418	0.548	80.0	23.4
32.0	3.534	0.661	81.4	28.7
34.0	3.616	0.810	61.4	47.7
36.0	3.616	0.732	86.7	30.5
38.0	3.702	0.880	64.8	50.3
41.0	3.702	0.898	60.2	55.2
45.0	3.840	0.932	43.3	82.7
50.0	3.793	0.921	52.5	66.5
55.0	3.937	0.951	40.0	93.6
60.0	3.937	0.942	47.2	78.6
65.0	3.888	0.971	28.3	133.4
70.0	3.937	0.971	29.5	129.6
75.0	3.888	0.972	32.3	117.0
80.0	3.937	0.974	24.3	157.7
85.0	3.240	0.994	8.5	378.7
90.0	4.203	0.989	15.8	263.1
100.0	3.840	0.992	12.5	304.6

28.0	3.534	0.417	103.6	14.2
30.0	3.494	0.418	103.6	14.1
32.0	3.456	0.570	107.9	18.2
34.0	3.494	0.677	88.9	26.6
36.0	3.616	0.708	88.6	28.9
38.0	3.616	0.781	71.8	39.3
40.0	3.616	0.765	87.0	31.8
43.0	3.747	0.879	51.9	63.5
46.0	3.659	0.893	49.5	66.0
50.0	3.793	0.949	30.7	117.3
55.0	3.793	0.961	24.7	147.5
60.0	3.793	0.971	22.3	165.2
65.0	2.752	0.982	12.4	218.0
70.0	3.659	0.981	14.8	242.5
80.0	2.087	0.987	9.3	221.6
90.0	2.254	0.989	7.4	301.2
100.0	1.819	0.996	3.4	532.5

x = 800mm, y = 100mm Exp. DT5 Q_w = 34L/s D = 60mm x = 800mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.802	0.045	106.5	1.2
15.0	3.049	0.073	149.0	1.5
20.0	3.049	0.093	160.7	1.8
25.0	3.110	0.104	153.9	2.1
30.0	3.309	0.220	195.1	3.7
34.0	3.344	0.340	185.0	6.2
38.0	3.418	0.547	177.0	10.6
42.0	3.494	0.689	134.8	17.9
46.0	3.575	0.794	112.2	25.3
50.0	3.380	0.871	91.1	32.3
55.0	3.380	0.919	64.9	47.9
60.0	3.141	0.935	52.0	56.5
65.0	2.907	0.932	58.3	46.5
70.0	2.704	0.929	56.5	44.4
75.0	2.508	0.929	52.5	44.4
80.0	2.488	0.932	49.4	46.9
85.0	2.430	0.915	53.8	41.3
90.0	2.287	0.907	55.5	37.4
95.0	2.287	0.917	45.5	46.1
100.0	2.145	0.940	34.2	59.0
105.0	1.994	0.949	31.0	61.1
110.0	2.019	0.966	16.2	120.4
115.0	2.101	0.961	21.1	95.7
120.0	1.920	0.968	13.9	133.7

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.592	0.021	59.6	0.9
15.0	2.704	0.035	89.8	1.1
22.0	2.907	0.050	115.1	1.3
29.0	2.934	0.066	140.3	1.4
35.0	2.802	0.085	156.1	1.5
40.0	3.110	0.143	190.7	2.3
45.0	3.079	0.213	218.7	3.0
50.0	3.309	0.286	232.5	4.1
55.0	3.240	0.379	241.3	5.1
60.0	3.274	0.491	234.7	6.8
65.0	3.240	0.580	236.9	7.9
70.0	3.240	0.603	215.2	9.1
75.0	3.141	0.622	202.5	9.7
80.0	3.173	0.586	194.5	9.6
85.0	2.777	0.625	177.0	9.8
90.0	2.411	0.606	164.2	8.9
95.0	2.287	0.677	129.3	12.0
100.0	2.190	0.718	114.1	13.8
105.0	2.033	0.773	91.9	17.1
110.0	1.908	0.868	53.3	31.1
115.0	2.116	0.913	38.0	50.8
120.0	1.920	0.945	24.6	73.7
130.0	1.787	0.986	7.2	244.7
140.0	2.060	0.990	5.1	400.0

135.0	1.819	0.996	1.8	1006.4
150.0	1.318	0.998	0.9	1461.9

150.0	1.968	0.999	1.1	1788.0

x = 1000mm, y = 0mm Exp. DT5 Q_w = 34L/s D = 60mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.962	0.016	44.0	1.1
9.0	3.173	0.030	67.2	1.4
12.0	3.110	0.050	90.8	1.7
15.0	3.110	0.077	104.8	2.3
18.0	3.240	0.118	119.1	3.2
21.0	3.380	0.220	146.3	5.1
24.0	3.494	0.357	151.6	8.2
27.0	3.534	0.431	157.8	9.6
30.0	3.494	0.573	160.4	12.5
33.0	3.534	0.641	161.6	14.0
36.0	3.534	0.726	136.5	18.8
39.0	3.575	0.757	129.5	20.9
42.0	3.534	0.830	100.0	29.3
45.0	3.575	0.845	101.6	29.7
48.0	3.534	0.891	80.9	38.9
51.0	3.575	0.898	74.8	42.9
55.0	3.494	0.927	62.6	51.8
60.0	3.494	0.937	55.2	59.3
65.0	3.494	0.949	48.3	68.6
70.0	3.494	0.958	42.7	78.4
75.0	3.418	0.971	32.8	101.1
80.0	3.494	0.975	25.1	135.8
90.0	3.575	0.983	20.4	172.2
100.0	3.616	0.986	16.7	213.5
115.0	3.494	0.987	14.7	234.7

x = 1000mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.049	0.022	58.6	1.2
9.0	3.049	0.039	88.4	1.4
12.0	3.173	0.068	106.4	2.0
15.0	3.173	0.092	121.0	2.4
18.0	3.274	0.173	150.6	3.8
21.0	3.380	0.201	147.3	4.6
24.0	3.418	0.303	167.8	6.2
27.0	3.494	0.374	159.0	8.2
30.0	3.534	0.475	172.8	9.7
33.0	3.616	0.591	156.7	13.6
36.0	3.575	0.594	167.4	12.7
39.0	3.659	0.696	151.5	16.8
42.0	3.616	0.745	137.5	19.6
45.0	3.616	0.803	119.5	24.3
48.0	3.659	0.800	118.8	24.6
51.0	3.616	0.858	100.2	31.0
55.0	3.616	0.882	87.5	36.4
60.0	3.616	0.907	76.7	42.8
65.0	3.659	0.927	63.1	53.7
70.0	3.659	0.946	54.0	64.1
75.0	3.575	0.945	54.9	61.6
80.0	3.616	0.961	42.5	81.8
90.0	3.659	0.975	30.6	116.6
100.0	3.534	0.984	18.9	184.0
115.0	3.575	0.987	15.2	232.1

x = 1000mm, y = 50mm Exp. DT5 Q_w = 34L/s D = 60mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.206	0.017	48.3	1.1
9.0	3.049	0.027	61.8	1.3
12.0	3.206	0.058	96.4	1.9
15.0	3.173	0.108	114.8	3.0
18.0	3.380	0.174	134.0	4.4
21.0	3.456	0.318	150.2	7.3
24.0	3.534	0.377	164.9	8.1
27.0	3.534	0.453	165.7	9.7
30.0	3.616	0.636	154.9	14.9
33.0	3.575	0.641	149.4	15.3

x = 1000mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	3.110	0.023	56.3	1.3
9.0	3.141	0.037	76.5	1.5
12.0	3.240	0.065	105.7	2.0
15.0	3.206	0.126	141.5	2.8
18.0	3.344	0.202	152.4	4.4
21.0	3.418	0.339	166.4	7.0
24.0	3.494	0.484	170.8	9.9
27.0	3.418	0.525	173.4	10.4
30.0	3.456	0.643	154.7	14.4
33.0	3.494	0.681	147.8	16.1

36.0	3.616	0.728	130.3	20.2
39.0	3.659	0.762	115.0	24.2
42.0	3.659	0.815	117.0	25.5
45.0	3.659	0.842	100.2	30.7
48.0	3.659	0.846	97.8	31.7
51.0	3.659	0.872	88.4	36.1
55.0	3.659	0.875	88.6	36.1
60.0	3.659	0.913	69.1	48.3
65.0	3.575	0.935	55.5	60.2
70.0	3.702	0.939	54.7	63.6
75.0	3.575	0.948	46.8	72.4
80.0	3.659	0.963	37.3	94.5
90.0	3.575	0.970	31.6	109.7
100.0	3.534	0.987	14.0	249.2
115.0	3.575	0.992	9.0	393.9

36.0	3.494	0.757	133.2	19.8
40.0	3.494	0.797	120.4	23.1
45.0	3.456	0.841	104.1	27.9
50.0	3.418	0.869	93.2	31.9
55.0	3.418	0.906	72.2	42.9
60.0	3.380	0.907	70.5	43.5
65.0	3.380	0.916	65.4	47.3
70.0	3.344	0.940	49.2	63.9
80.0	3.206	0.949	37.4	81.4
90.0	2.907	0.967	27.4	102.6
100.0	2.990	0.974	17.1	170.4
115.0	3.019	0.987	11.6	256.8
130.0	2.613	0.996	3.4	765.3

x = 1000mm, y = 100mm Exp. DT5 Q_w = 34L/s D = 60mm x = 1000mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.934	0.023	55.4	1.2
10.0	3.049	0.048	91.9	1.6
15.0	3.110	0.103	141.6	2.3
20.0	3.141	0.147	163.4	2.8
25.0	3.110	0.188	180.3	3.3
30.0	3.173	0.211	180.1	3.7
35.0	3.274	0.311	186.1	5.5
40.0	3.274	0.463	190.3	8.0
45.0	3.309	0.563	184.3	10.1
50.0	3.274	0.647	166.8	12.7
55.0	3.240	0.743	139.2	17.3
60.0	3.110	0.785	123.2	19.8
65.0	3.173	0.844	97.6	27.4
70.0	3.049	0.833	111.8	22.7
75.0	3.019	0.839	104.3	24.3
80.0	2.853	0.848	90.2	26.8
85.0	2.853	0.845	90.5	26.6
90.0	2.752	0.878	80.0	30.2
95.0	2.728	0.890	73.3	33.1
100.0	2.728	0.903	60.0	41.0
105.0	2.681	0.921	48.1	51.3
110.0	2.658	0.944	37.7	66.5
115.0	2.681	0.959	24.1	106.7
120.0	2.508	0.959	24.2	99.4
130.0	2.570	0.984	10.2	248.1
145.0	2.488	0.997	2.1	1180.8

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.321	0.008	26.0	0.7
15.0	2.658	0.020	52.2	1.0
25.0	2.704	0.025	62.1	1.1
30.0	2.704	0.031	71.5	1.2
35.0	2.528	0.035	78.1	1.1
40.0	2.592	0.035	74.9	1.2
45.0	2.592	0.052	91.1	1.5
50.0	2.827	0.099	110.2	2.5
55.0	2.802	0.099	121.3	2.3
60.0	2.907	0.181	143.5	3.7
65.0	2.880	0.239	151.3	4.6
70.0	2.827	0.252	151.9	4.7
75.0	2.728	0.313	152.4	5.6
80.0	2.613	0.340	153.1	5.8
85.0	2.592	0.422	138.5	7.9
90.0	2.613	0.522	136.8	10.0
95.0	2.392	0.628	113.9	13.2
100.0	2.468	0.697	101.0	17.0
105.0	2.488	0.764	82.2	23.1
110.0	2.374	0.847	57.5	35.0
115.0	2.430	0.876	43.4	49.0
120.0	2.356	0.945	26.0	85.6
125.0	2.592	0.952	22.3	110.7
130.0	2.549	0.975	12.3	202.1
140.0	2.570	0.993	5.1	500.5
150.0	2.430	0.996	2.1	1152.0

x = 1200mm, y = 0mm		Exp. DT5		Q_w = 34L/s	D = 60mm				x = 1200mm, y = 25mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.990	0.007	19.8	1.0	5.0	3.019	0.009	24.8	1.0
9.0	3.079	0.016	41.5	1.2	9.0	3.019	0.027	57.2	1.4
12.0	2.962	0.032	69.8	1.4	12.0	3.110	0.042	79.9	1.6
14.0	3.019	0.045	82.8	1.6	14.0	3.019	0.061	98.4	1.9
16.0	3.079	0.077	102.8	2.3	16.0	3.049	0.097	125.3	2.4
18.0	3.141	0.115	129.0	2.8	18.0	3.206	0.139	134.6	3.3
20.0	3.418	0.231	149.4	5.3	20.0	3.456	0.228	156.6	5.0
22.0	3.418	0.276	166.5	5.7	22.0	3.418	0.277	169.2	5.6
24.0	3.380	0.335	167.6	6.8	24.0	3.534	0.431	183.7	8.3
26.0	3.456	0.488	146.1	11.5	26.0	3.534	0.485	186.4	9.2
28.0	3.494	0.647	137.6	16.4	28.0	3.575	0.620	160.7	13.8
30.0	3.494	0.720	117.0	21.5	30.0	3.575	0.695	143.7	17.3
32.0	3.534	0.773	114.9	23.8	32.0	3.575	0.766	121.5	22.5
34.0	3.575	0.846	90.3	33.5	34.0	3.575	0.819	104.7	28.0
36.0	3.534	0.881	78.1	39.9	36.0	3.616	0.875	88.4	35.8
38.0	3.575	0.925	59.0	56.1	38.0	3.659	0.906	74.9	44.2
41.0	3.616	0.936	52.2	64.8	40.0	3.616	0.911	71.9	45.8
45.0	3.659	0.955	38.8	90.0	45.0	3.616	0.938	55.4	61.2
50.0	3.575	0.970	27.0	128.4	50.0	3.702	0.957	39.4	89.9
55.0	3.616	0.970	29.3	119.7	55.0	3.702	0.962	35.1	101.5
60.0	3.659	0.977	22.3	160.3	60.0	3.616	0.965	31.8	109.7
70.0	3.659	0.982	18.1	198.6	70.0	3.616	0.977	22.7	155.6
80.0	3.616	0.986	14.2	251.2	80.0	3.747	0.986	15.1	244.7
90.0	3.616	0.991	8.6	416.8	95.0	3.659	0.991	10.8	335.7
105.0	3.575	0.992	7.9	449.1	110.0	3.616	0.992	10.4	344.8

x = 1200mm, y = 50mm		Exp. DT5		Q_w = 34L/s	D = 60mm				x = 1200mm, y = 75mm
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.934	0.009	24.0	1.1	5.0	3.049	0.008	19.8	1.2
10.0	3.173	0.026	62.5	1.3	10.0	3.141	0.025	55.8	1.4
15.0	3.141	0.056	95.5	1.9	15.0	3.141	0.055	99.6	1.7
18.0	3.141	0.099	134.4	2.3	18.0	3.141	0.065	118.0	1.7
20.0	3.173	0.141	153.1	2.9	21.0	3.079	0.086	125.8	2.1
22.0	3.206	0.211	182.5	3.7	24.0	3.019	0.128	163.3	2.4
24.0	3.274	0.242	195.5	4.0	27.0	3.141	0.165	179.6	2.9
26.0	3.456	0.322	201.6	5.5	30.0	3.079	0.220	206.4	3.3
28.0	3.456	0.427	220.4	6.7	33.0	3.141	0.307	213.7	4.5
30.0	3.494	0.515	211.8	8.5	36.0	3.206	0.403	237.4	5.4
32.0	3.494	0.567	223.6	8.9	39.0	3.173	0.509	222.7	7.3
34.0	3.494	0.639	207.6	10.8	42.0	3.141	0.537	227.1	7.4
36.0	3.534	0.747	171.8	15.4	45.0	3.344	0.696	182.9	12.7
38.0	3.534	0.806	139.0	20.5	48.0	3.206	0.729	173.7	13.5

40.0	3.494	0.828	135.5	21.4	51.0	3.206	0.808	136.0	19.1
42.0	3.534	0.850	117.7	25.5	54.0	3.240	0.835	125.1	21.6
44.0	3.534	0.888	98.0	32.0	57.0	3.173	0.895	94.9	29.9
47.0	3.575	0.917	78.6	41.7	60.0	3.274	0.896	83.5	35.1
50.0	3.575	0.924	69.6	47.5	65.0	3.274	0.932	59.3	51.4
55.0	3.575	0.946	52.8	64.0	70.0	3.240	0.950	45.2	68.1
60.0	3.616	0.963	37.2	93.6	75.0	3.344	0.969	28.7	112.9
70.0	3.747	0.974	22.7	160.8	80.0	3.380	0.981	17.0	195.1
80.0	3.616	0.984	17.4	204.4	90.0	3.534	0.980	15.3	226.4
95.0	3.659	0.992	7.5	484.2	105.0	3.309	0.988	9.4	347.8
110.0	3.534	0.995	4.4	799.1	120.0	3.534	0.998	2.4	1468.9

x = 1200mm, y = 100mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 1200mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.880	0.008	19.6	1.2	5.0	2.116	0.003	8.8	0.7
15.0	3.019	0.047	93.3	1.5	15.0	2.613	0.016	38.0	1.1
20.0	3.049	0.065	111.7	1.8	20.0	2.592	0.015	35.6	1.1
25.0	2.962	0.076	133.0	1.7	25.0	2.528	0.015	33.0	1.2
30.0	2.907	0.082	121.6	2.0	30.0	2.449	0.013	28.0	1.1
35.0	2.880	0.098	135.4	2.1	35.0	2.430	0.014	28.7	1.2
39.0	2.934	0.144	156.1	2.7	40.0	2.321	0.026	38.7	1.6
42.0	2.880	0.162	162.8	2.9	44.0	2.130	0.042	51.8	1.7
45.0	2.907	0.224	176.7	3.7	48.0	2.304	0.122	98.9	2.8
48.0	2.962	0.240	187.8	3.8	52.0	2.468	0.203	125.3	4.0
51.0	2.934	0.338	190.8	5.2	56.0	2.549	0.318	145.3	5.6
54.0	3.019	0.396	188.9	6.3	60.0	2.681	0.515	152.1	9.1
57.0	2.990	0.422	194.8	6.5	64.0	2.777	0.684	128.9	14.7
60.0	3.019	0.558	173.5	9.7	68.0	2.802	0.772	100.9	21.4
63.0	3.049	0.692	143.9	14.7	72.0	2.934	0.826	80.1	30.3
66.0	3.110	0.709	134.2	16.4	76.0	2.934	0.877	58.0	44.4
69.0	3.079	0.781	112.0	21.5	80.0	2.853	0.919	39.0	67.3
72.0	3.049	0.832	94.2	26.9	84.0	3.019	0.949	24.2	118.4
75.0	3.141	0.878	73.3	37.6	88.0	2.962	0.942	30.2	92.4
80.0	3.079	0.884	64.9	42.0	92.0	3.110	0.972	16.4	184.3
85.0	3.240	0.930	44.9	67.1	96.0	3.049	0.980	13.8	216.4
90.0	3.173	0.949	33.3	90.5	100.0	3.019	0.982	9.1	326.0
100.0	3.380	0.981	12.6	263.2	110.0	3.702	0.995	3.6	1023.7
110.0	3.240	0.994	5.0	644.0	120.0	2.681	0.996	2.6	1027.4
120.0	3.049	0.995	2.5	1213.7	130.0	3.575	0.999	0.5	7142.5

x = 1400mm, y = 0mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 1400mm, y = 25mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.827	0.003	8.5	1.0	5.0	2.853	0.005	11.8	1.1
10.0	2.962	0.008	19.4	1.2	10.0	3.049	0.013	31.3	1.3

15.0	2.907	0.024	47.1	1.5
18.0	2.907	0.048	66.6	2.1
20.0	2.934	0.097	108.2	2.6
22.0	3.141	0.130	117.5	3.5
24.0	3.494	0.270	169.4	5.6
26.0	3.534	0.395	176.9	7.9
28.0	3.494	0.502	181.6	9.7
30.0	3.575	0.666	180.9	13.2
32.0	3.575	0.783	145.3	19.3
34.0	3.575	0.876	99.1	31.6
36.0	3.534	0.903	88.9	35.9
38.0	3.575	0.947	59.5	56.9
40.0	3.575	0.960	46.3	74.1
42.0	3.575	0.971	32.1	108.1
45.0	3.494	0.987	18.4	187.5
50.0	3.793	0.989	12.9	290.7
60.0	3.793	0.992	7.4	508.4
75.0	3.840	0.997	2.6	1472.0
90.0	3.937	0.999	2.0	1965.5

15.0	2.934	0.031	64.8	1.4
18.0	2.934	0.053	89.4	1.7
20.0	3.019	0.098	116.1	2.6
22.0	3.079	0.134	148.5	2.8
24.0	3.240	0.217	184.7	3.8
26.0	3.344	0.259	205.6	4.2
28.0	3.456	0.339	218.3	5.4
30.0	3.456	0.475	250.3	6.6
32.0	3.456	0.611	230.7	9.2
34.0	3.456	0.673	213.8	10.9
36.0	3.418	0.731	204.6	12.2
38.0	3.418	0.775	184.7	14.3
40.0	3.418	0.838	152.2	18.8
42.0	3.380	0.872	134.7	21.9
44.0	3.380	0.886	118.1	25.4
47.0	3.418	0.943	60.4	53.4
50.0	3.380	0.959	50.1	64.7
55.0	3.418	0.976	30.4	109.7
60.0	3.534	0.988	14.6	239.1
70.0	3.575	0.994	5.9	602.5
80.0	4.039	0.996	3.4	1183.2

x = 1400mm, *y* = 50mm		Exp. DT5		Q_w = 34L/s		*D* = 60mm		*x* = 1400mm, *y* = 75mm	
z [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]	*z* [mm]	*V* [m/s]	*C*	F_a [Hz]	ch_a [mm]
5.0	2.962	0.005	12.7	1.2	5.0	2.934	0.005	11.2	1.2
10.0	3.049	0.016	37.1	1.3	14.0	3.049	0.029	58.6	1.5
15.0	3.079	0.039	79.1	1.5	20.0	3.049	0.047	87.4	1.6
20.0	3.019	0.057	102.4	1.7	25.0	2.962	0.068	111.2	1.8
24.0	3.049	0.113	159.2	2.2	30.0	2.880	0.080	129.8	1.8
27.0	3.019	0.147	180.0	2.5	35.0	2.880	0.103	140.6	2.1
30.0	3.019	0.189	206.0	2.8	38.0	2.907	0.130	159.1	2.4
32.0	3.110	0.223	206.8	3.4	40.0	2.934	0.181	182.5	2.9
34.0	3.079	0.239	228.7	3.2	42.0	2.907	0.246	188.0	3.8
36.0	3.110	0.290	250.2	3.6	44.0	3.019	0.290	211.7	4.1
38.0	3.110	0.383	256.5	4.6	46.0	3.079	0.398	219.6	5.6
40.0	3.173	0.432	262.5	5.2	48.0	3.079	0.465	217.3	6.6
42.0	3.240	0.542	271.0	6.5	50.0	3.141	0.628	202.9	9.7
44.0	3.173	0.589	254.3	7.3	52.0	3.141	0.699	174.0	12.6
46.0	3.274	0.708	219.0	10.6	54.0	3.173	0.792	141.5	17.8
48.0	3.240	0.710	210.9	10.9	56.0	3.206	0.832	124.3	21.5
50.0	3.240	0.798	173.6	14.9	58.0	3.274	0.864	105.1	26.9
52.0	3.309	0.857	131.7	21.5	60.0	3.240	0.932	63.1	47.8
55.0	3.240	0.910	98.5	29.9	62.0	3.274	0.949	46.5	66.8
60.0	3.309	0.954	53.9	58.5	65.0	3.274	0.959	40.8	76.9

65.0	3.418	0.981	24.0	139.6
70.0	3.418	0.984	14.7	228.8
80.0	3.840	0.997	4.6	832.0
95.0	3.888	0.996	3.4	1139.2

70.0	3.702	0.992	10.1	363.8
75.0	3.380	0.992	8.3	404.0
80.0	3.575	0.994	6.7	530.3
90.0	3.616	0.996	3.4	1059.1
100.0	3.616	0.998	3.0	1202.6

x = 1400mm, y = 100mm Exp. DT5 Q_w = 34L/s D = 60mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.880	0.003	8.5	1.0
14.0	2.962	0.019	39.1	1.4
20.0	2.934	0.035	65.9	1.5
25.0	2.907	0.046	84.4	1.6
30.0	2.802	0.049	84.6	1.6
35.0	2.777	0.057	90.6	1.7
38.0	2.752	0.078	99.8	2.1
40.0	2.777	0.092	104.5	2.4
42.0	2.827	0.140	121.9	3.2
44.0	2.934	0.188	146.4	3.8
46.0	2.990	0.288	163.5	5.3
48.0	3.049	0.406	160.8	7.7
50.0	3.079	0.533	162.4	10.1
52.0	3.141	0.665	138.8	15.0
54.0	3.173	0.782	104.4	23.8
56.0	3.141	0.865	78.2	34.7
58.0	3.206	0.898	68.3	42.1
60.0	3.240	0.939	45.5	66.9
62.0	3.206	0.928	48.3	61.6
65.0	3.494	0.976	19.5	175.0
70.0	3.344	0.985	14.8	222.6
75.0	3.344	0.991	10.1	328.1
80.0	2.827	0.991	6.8	412.1
90.0	3.659	0.997	2.5	1458.7

x = 1400mm, y = 120mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
5.0	2.528	0.003	6.5	1.0
14.0	2.636	0.009	19.3	1.2
20.0	2.430	0.012	24.5	1.2
25.0	2.374	0.012	23.1	1.2
30.0	2.175	0.033	42.8	1.7
33.0	2.338	0.036	53.5	1.6
36.0	2.321	0.102	103.1	2.3
38.0	2.430	0.126	114.3	2.7
40.0	2.528	0.210	162.1	3.3
42.0	2.430	0.263	167.9	3.8
44.0	2.528	0.342	195.0	4.4
46.0	2.658	0.455	191.9	6.3
48.0	2.592	0.557	193.3	7.5
50.0	2.681	0.657	180.5	9.8
52.0	2.728	0.778	139.9	15.2
54.0	2.777	0.865	95.4	25.2
56.0	2.777	0.916	62.1	41.0
58.0	2.880	0.952	36.0	76.1
60.0	2.934	0.946	42.2	65.8
63.0	2.934	0.967	28.2	100.6
66.0	3.840	0.982	14.4	261.9
70.0	2.934	0.989	8.7	333.6
75.0	3.702	0.998	2.3	1606.5
80.0	3.206	0.998	2.3	1391.7
90.0	3.494	0.997	2.4	1451.9

x = 1800mm, y = 0mm Exp. DT5 Q_w = 34L/s D = 60mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
20.0	3.019	0.006	12.8	1.3
30.0	2.962	0.027	46.4	1.7
40.0	2.907	0.052	85.9	1.8
45.0	2.934	0.081	118.8	2.0
50.0	3.049	0.142	155.5	2.8
52.0	3.110	0.193	202.8	3.0
54.0	3.206	0.255	237.7	3.4

x = 1800mm, y = 25mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.934	0.002	5.2	1.2
20.0	2.962	0.013	27.1	1.5
30.0	2.962	0.039	67.0	1.7
35.0	2.880	0.056	89.0	1.8
40.0	2.934	0.130	149.9	2.5
42.0	3.141	0.220	191.7	3.6
44.0	3.141	0.267	211.9	4.0

56.0	3.240	0.318	241.2	4.3
58.0	3.309	0.368	257.3	4.7
60.0	3.309	0.452	260.5	5.7
62.0	3.344	0.503	267.3	6.3
64.0	3.344	0.614	240.1	8.6
66.0	3.344	0.677	236.0	9.6
68.0	3.344	0.694	224.4	10.3
70.0	3.344	0.763	200.1	12.8
72.0	3.344	0.832	155.9	17.8
75.0	3.380	0.864	136.7	21.4
80.0	3.380	0.931	83.9	37.5
85.0	3.418	0.973	37.7	88.2
90.0	3.456	0.984	22.7	149.8
100.0	3.456	0.997	5.2	662.4
110.0	4.092	1.000	0.8	5113.8

46.0	3.274	0.378	229.8	5.4
48.0	3.274	0.456	231.3	6.4
50.0	3.309	0.548	226.5	8.0
52.0	3.344	0.585	225.3	8.7
54.0	3.344	0.619	215.2	9.6
56.0	3.418	0.694	196.1	12.1
58.0	3.380	0.774	161.1	16.2
60.0	3.456	0.792	160.5	17.1
63.0	3.494	0.831	145.3	20.0
66.0	3.494	0.870	119.3	25.5
70.0	3.456	0.885	113.8	26.9
75.0	3.456	0.945	67.0	48.7
80.0	3.534	0.968	43.1	79.4
85.0	3.494	0.981	24.7	138.8
90.0	3.418	0.991	16.2	209.0
100.0	3.110	0.998	4.8	646.4

x = 1800mm, y = 50mm Exp. DT5 Q_w = 34L/s D = 60mm x = 1800mm, y = 75mm

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.827	0.003	7.1	1.1
20.0	2.907	0.023	43.4	1.5
26.0	2.880	0.045	69.0	1.9
30.0	2.802	0.079	96.6	2.3
32.0	2.934	0.110	121.5	2.7
34.0	3.079	0.181	151.3	3.7
36.0	3.173	0.265	173.5	4.9
38.0	3.309	0.465	218.7	7.0
40.0	3.309	0.515	211.0	8.1
42.0	3.380	0.740	169.5	14.8
44.0	3.380	0.876	106.9	27.7
46.0	3.380	0.886	109.0	27.5
48.0	3.418	0.899	77.3	39.7
50.0	3.456	0.956	46.5	71.1
55.0	3.534	0.980	22.9	151.2
60.0	3.494	0.981	23.4	146.5
65.0	3.456	0.979	26.2	129.1
70.0	3.575	0.990	11.7	302.5
75.0	3.616	0.993	8.9	403.7
80.0	3.494	0.997	4.2	829.7
90.0	3.702	0.999	2.2	1680.8

z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.777	0.002	5.5	1.1
20.0	2.827	0.023	44.3	1.5
25.0	2.752	0.045	65.8	1.9
28.0	2.827	0.081	94.1	2.4
30.0	2.962	0.137	118.9	3.4
31.0	3.019	0.191	148.0	3.9
32.0	3.110	0.256	162.2	4.9
33.0	3.240	0.333	177.4	6.1
34.0	3.240	0.415	173.9	7.7
35.0	3.274	0.520	180.9	9.4
36.0	3.274	0.542	178.3	10.0
37.0	3.309	0.640	171.4	12.4
38.0	3.309	0.726	159.8	15.0
39.0	3.380	0.801	120.0	22.6
40.0	3.309	0.824	120.6	22.6
42.0	3.344	0.898	80.1	37.5
45.0	3.309	0.970	30.3	105.9
50.0	3.456	0.998	2.4	1436.7
55.0	3.987	0.998	1.8	2211.0
60.0	4.147	0.999	1.6	2589.6

x = 1800mm, y = 100mm		Exp. DT5		Q_w = 34L/s		D = 60mm		x = 1800mm, y = 120mm	
z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]	z [mm]	V [m/s]	C	F_a [Hz]	ch_a [mm]
10.0	2.658	0.004	8.4	1.3	10.0	2.356	0.009	15.5	1.3
20.0	2.704	0.023	37.9	1.6	20.0	2.411	0.026	36.9	1.7
25.0	2.613	0.046	62.4	1.9	25.0	2.356	0.071	72.6	2.3
28.0	2.728	0.108	94.8	3.1	28.0	2.411	0.107	98.5	2.6
30.0	2.990	0.196	128.4	4.6	30.0	2.549	0.276	161.5	4.3
31.0	3.079	0.308	152.2	6.2	31.0	2.411	0.271	160.2	4.1
32.0	3.141	0.364	153.5	7.5	32.0	2.528	0.340	163.8	5.3
33.0	3.079	0.384	153.4	7.7	33.0	2.613	0.409	170.0	6.3
34.0	3.173	0.523	144.9	11.5	34.0	2.613	0.462	180.8	6.7
35.0	3.173	0.584	148.0	12.5	35.0	2.681	0.545	182.6	8.0
36.0	3.173	0.654	141.2	14.7	36.0	2.636	0.622	173.5	9.5
37.0	3.206	0.719	123.8	18.6	37.0	2.681	0.679	143.9	12.7
38.0	3.141	0.853	87.1	30.8	38.0	2.728	0.740	131.1	15.4
39.0	3.240	0.854	88.5	31.3	39.0	2.728	0.785	131.1	16.3
40.0	3.240	0.891	66.4	43.5	40.0	2.802	0.855	99.0	24.2
42.0	3.274	0.963	29.4	107.2	42.0	2.827	0.916	66.2	39.1
45.0	3.206	0.985	15.7	201.2	45.0	2.880	0.982	15.3	184.8
50.0	3.344	0.999	1.3	2569.6	50.0	3.494	0.997	2.9	1201.4
55.0	3.380	0.999	1.3	2597.4	55.0	3.456	1.000	0.9	3837.9

APPENDIX J – DISSOLVED OXYGEN CONCENTRATION DATA

J.1 RE-OXYGENATION POTENTIAL OF THE MULTI-STEP CASCADE SYSTEM

The oxygenation performance of the multi-step cascade (Table J-1, Figure J-1) was measured using a 90FLMV Microprocessor Field Analyser to obtain the dissolved oxygen content of the water, C_{gas}. Sodium Sulphite was used to initially de-oxygenate the water in the pit tank[a] (2 $NaSO_3 + O_2 \rightarrow 2\ NaSO_4$). The cascade was then operated and the dissolved oxygen (DO) concentration of the water at the lower end of the cascade (Figure J-1) was measured as a function of time.

Table J-1 Experimental channel details

		Multi-step
Channel Properties	– Length, L_{casc}	24.0m
	– Width, W	0.5m
	– Overall slope, α	3.4°
	– Tank volume	10.5m³
Step Properties	– Number of steps	10
	– Step height, h	0.143m
	– Step length, L	2.40m
Intake Characteristics	– Inlet height	0.03m
	– Inlet width	0.5m
	– Contraction coefficient	1.0

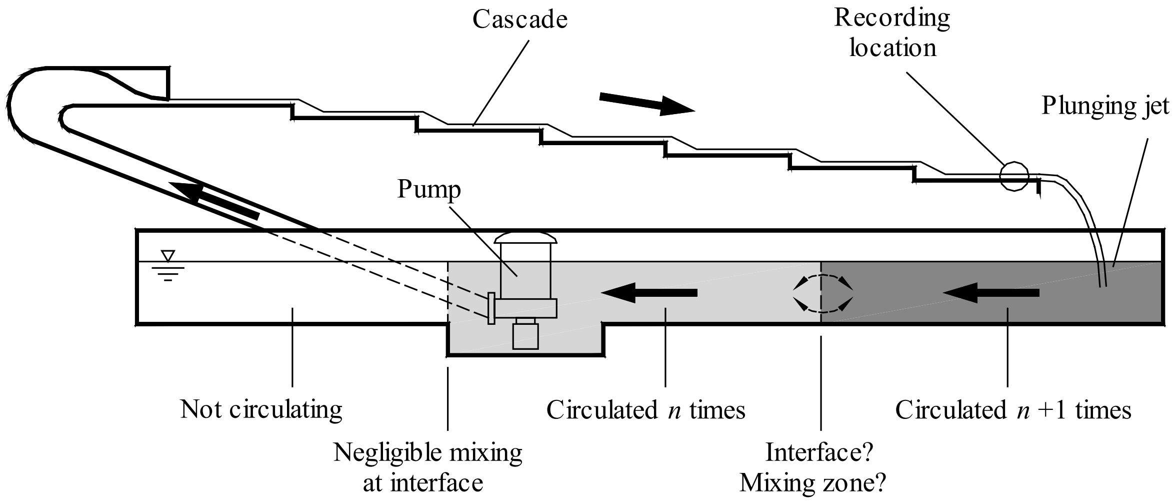

Figure J-1 Flow cycle of the re-oxygenation procedure (not to scale – number of steps reduced for clarity)

[a] Due to an excess of sodium sulphite in the water, there is likely to be a delay between the commencement of cascade operation and an increase in the DO content of the water.

J.2 EXPERIMENTAL DATA

Experimental flow conditions are listed in Table J-2. The results are listed in Table J-3, where 'Time' is the time since operation of the system was initiated, 'Recirc. Time' is the time for a complete cycle of the closed system (T_{recirc} = volume/flowrate) and C_{gas} is the dissolved oxygen content of the water, in ppm.

Table J-2 Experimental flow conditions

Exp.	Flowrate [m²/s]	Recirc. Time [s]	Water Temp [ºC]	Salinity [ppm]	Saturation Concentration [ppm]
DO1	0.038	552.6	18.7	552	9.460
DO2	0.038	552.6	18.6	610	9.476
DO3	0.060	350.0	19.2	375	9.375
DO4	0.060	350.0	19.2	428	9.372
DO5	0.080	262.5	19.0	261	9.419
DO6	0.080	262.5	18.9	359	9.432
DO7	0.092	228.3	18.8	418	9.448
DO8	0.092	228.3	18.7	474	9.464
DO9	0.110	190.9	17.7	207	0.923
DO10	0.110	190.9	17.7	281	9.670
DO11	0.126	166.7	18.6	611	9.476
DO12	0.126	166.7	19.3	311	9.359
DO13	0.150	140.0	17.7	364	9.666
DO14	0.150	140.0	17.7	431	9.662

Table J-3 Dissolved oxygen concentration measured at the downstream end of the cascade

Exp. DO1	Flowrate: q_w = 0.038m²/s		Recirc. Time: 553s		Water Temp.: 18.7ºC		Salinity: 552ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	3.23	330	2.70	630	1.39	1020	7.43
60	7.75	360	2.56	660	2.15	1140	7.43
90	2.94	390	2.41	690	3.06	1260	7.41
120	3.95	420	2.26	720	4.03	1320	7.53
150	3.32	450	2.03	750	4.95	1500	8.24
180	3.28	480	1.76	780	5.59	1800	8.74
210	3.34	510	1.33	810	5.95	2100	8.89
240	3.17	540	0.94	840	6.37	2520	9.01
270	3.06	570	0.71	900	7.01		
300	2.79	600	0.78	960	7.31		

Exp. DO2	Flowrate: q_w = 0.038m²/s		Recirc. Time: 553s		Water Temp.: 18.6ºC		Salinity: 610ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	4.76	420	3.39	660	4.87	1140	7.87
60	8.48	480	3.27	690	5.50	1380	8.48
135	2.87	540	2.95	720	5.95	1680	8.94
180	3.09	570	2.98	780	6.74	2100	9.17
300	2.97	600	3.57	840	7.25	2700	9.32
360	3.10	630	4.25	960	7.70		

Exp. DO3	Flowrate: q_w = 0.060m²/s		Recirc. Time: 350s		Water Temp.: 19.2ºC		Salinity: 375ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
60	5.81	345	2.76	480	6.56	960	8.74
120	3.94	360	3.15	525	7.30	1200	9.01
180	3.73	390	4.06	570	7.66		
240	3.00	420	5.01	660	7.79		
300	2.51	450	5.89	780	7.97		

Exp. DO4	Flowrate: q_w = 0.060m²/s		Recirc. Time: 350s		Water Temp.: 19.2ºC		Salinity: 428ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
60	6.44	360	2.17	540	7.21	1080	8.83
180	3.02	390	3.00	570	7.43	1200	8.92
240	2.98	420	4.17	660	7.67		
300	2.21	450	5.33	780	7.80		
330	2.02	480	6.23	960	8.62		

Exp. DO5	Flowrate: q_w = 0.080m²/s		Recirc. Time: 263s		Water Temp.: 19.0ºC		Salinity: 261ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	1.93	210	1.97	390	6.29	720	8.49
60	1.68	240	2.29	420	6.83	840	8.78
90	1.84	270	2.66	450	7.14	960	8.94
120	2.13	300	3.42	480	7.31	1200	9.14
150	1.80	330	4.47	540	7.48	1500	9.22
180	1.78	360	5.51	600	7.72	1620	9.23

Exp. DO6	Flowrate: q_w = 0.080m²/s		Recirc. Time: 263s		Water Temp.: 18.9ºC		Salinity: 359ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	1.93	210	1.97	390	6.29	720	8.49
60	1.68	240	2.29	420	6.83	840	8.78
90	1.84	270	2.66	450	7.14	960	8.94
120	2.13	300	3.42	480	7.31	1200	9.14
150	1.80	330	4.47	540	7.48	1500	9.22
180	1.78	360	5.51	600	7.72	1620	9.23

Exp. DO7	Flowrate: q_w = 0.092m²/s		Recirc. Time: 228s		Water Temp.: 18.8ºC		Salinity: 418ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	4.28	210	0.54	390	6.92	840	8.76
60	3.97	240	0.00	420	7.21	960	8.91
90	3.19	270	0.94	480	7.26	1200	9.01
120	2.90	300	3.11	540	7.43	1440	9.04
150	2.17	330	5.11	600	7.94		
180	1.32	360	6.32	720	8.57		

Exp. DO8	Flowrate: q_w = 0.092m²/s		Recirc. Time: 228s		Water Temp.: 18.7ºC		Salinity: 474ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	6.45	210	4.08	420	7.49	960	9.14
60	1.44	240	4.10	480	7.95	1200	9.24
90	1.44	270	4.40	540	8.17	1440	9.28
120	1.63	300	5.22	600	8.47		
150	2.99	330	6.04	720	8.84		
180	3.90	360	6.67	840	9.03		

Exp. DO9	Flowrate: q_w = 0.110m²/s	Recirc. Time: 191s		Water Temp.: 17.7ºC		Salinity: 207ppm	
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	8.32	330	6.79	630	8.25	1200	9.34
60	5.38	360	6.78	660	8.51	1320	9.38
90	4.56	390	7.21	720	8.74	1440	9.42
120	4.81	420	7.60	780	8.76	1590	9.44
150	5.18	450	7.84	840	8.88	1740	9.42
180	5.42	480	7.81	900	9.04	1860	8.33
210	5.81	510	7.76	960	9.16	2100	9.43
240	6.63	540	7.72	1020	9.20		
270	7.19	570	7.78	1080	9.25		
300	7.10	600	7.98	1140	9.31		

Exp. DO10	Flowrate: q_w = 0.110m²/s	Recirc. Time: 191s		Water Temp.: 17.7ºC		Salinity: 281ppm	
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
60	0.29	240	4.34	450	7.44	720	9.00
75	0.38	270	4.76	480	7.86	780	9.16
90	0.85	300	5.10	510	8.15	840	9.23
120	2.13	330	5.50	540	8.26	900	9.25
150	2.97	360	6.02	570	8.47	1020	9.35
180	3.40	390	6.53	600	8.60	1200	9.38
210	3.75	420	6.98	660	8.84	1620	9.34

Exp. DO11	Flowrate: q_w = 0.126m²/s	Recirc. Time: 167s		Water Temp.: 18.6ºC		Salinity: 611ppm	
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	2.76	180	0.00	330	7.18	540	8.96
60	0.85	210	2.20	360	7.35	660	9.23
90	0.27	240	4.90	390	7.59	720	9.33
120	0.00	270	6.20	420	7.93	870	9.43
150	0.00	300	6.89	480	8.62		

Exp. DO12	Flowrate: q_w = 0.126m²/s	Recirc. Time: 167s		Water Temp.: 19.3ºC		Salinity: 311ppm	
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	4.11	210	2.54	300	6.54	660	9.00
60	0.15	225	3.66	330	6.91	720	9.09
90	0.00	240	4.62	360	7.15	840	9.18
120	0.00	255	5.48	420	7.69	1020	9.22
150	0.09	270	5.97	480	8.40	1140	9.23
180	0.51	285	6.33	540	8.70		

Exp. DO13	Flowrate: q_w = 0.150m²/s		Recirc. Time: 140s		Water Temp.: 17.7ºC		Salinity: 364ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	6.49	210	4.86	300	7.10	480	8.83
60	5.15	225	5.75	330	7.18	510	8.93
90	4.43	240	6.40	360	7.51	570	9.09
120	3.73	255	6.79	390	8.03	660	9.28
150	3.02	270	7.00	420	8.42	780	9.37
180	3.12	285	7.10	450	8.68	900	9.40

Exp. DO14	Flowrate: q_w = 0.150m²/s		Recirc. Time: 140s		Water Temp.: 17.7ºC		Salinity: 431ppm
Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]	Time [s]	C_{gas} [ppm]
30	2.13	120	3.54	240	6.37	480	8.59
45	2.33	135	3.77	270	6.59	600	9.13
60	2.31	150	3.93	300	6.85	720	9.33
75	2.51	165	4.20	330	7.15	900	9.44
90	2.78	180	4.79	360	7.58		
105	3.27	210	5.82	420	8.22		

J.3 RE-OXYGENATION POTENTIAL OF THE PLUNGING JET

Water samples were taken from the pit tank just downstream of the plunging jet impact (Figure J-1) while the system was in operation. The dissolved oxygen concentration of the samples from the tank (C_{DS}) were compared to the dissolved oxygen concentration recorded at the end of the cascade (C_{US}) to enable calculation of the aeration efficiency of the free-falling jet/plunge pool at the end of the cascade. The data is listed in Table J-4. Unfortunately, some data were possibly recorded too early in the re-oxygenation cycle (i.e. the data are potentially affected by unreacted sodium sulphite etc.). These data are highlighted in small *Italics*.

Table J-4 Plunging jet dissolved oxygen concentrations

q_w [m²/s]	t/T_{recirc}	C_{US}/C_{SAT}	C_{DS}/C_{SAT}	$E(O_2)$
0.038	0.434	0.336	0.639	0.46
	0.543	0.295	0.651	0.50
	0.651	0.271	0.685	0.57
0.080	1.371	0.451	0.756	0.55
	1.600	0.615	0.830	0.56
	1.829	0.718	0.874	0.55
0.092	*0.789*	*0.139*	*0.689*	*0.64*
	1.051	*0.000*	*0.632*	*0.63*
	1.314	0.329	0.732	0.60
0.092	*0.526*	*0.172*	*0.681*	*0.61*
	0.789	0.412	0.696	0.48
	1.051	0.434	0.753	0.56
0.110	*0.786*	*0.307*	*0.525*	*0.31*
	1.257	0.449	0.670	0.40
0.126	*0.720*	*0.000*	*0.564*	*0.56*
	1.080	*0.000*	*0.506*	*0.51*
	1.440	0.517	0.718	0.42
0.126	*0.540*	*0.000*	*0.485*	*0.48*
	0.900	*0.009*	*0.554*	*0.55*
	1.260	0.271	0.612	0.47